UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

DATE: March 27, 2002

SUBJECT: National Remedy Review Board Remedy Selection Briefing Package, Maryland Sand, Gravel and Stone Site, OU3, Elkton, MD

FROM: Debra Rossi, Remedial Project Manager

TO: All NRRB Members

Enclosed is a copy of the Remedy Selection Briefing Package for Operable Unit Three at the Maryland Sand, Gravel and Stone site (Site) in Elkton, Maryland. This Site is scheduled for discussion during the next Remedy Review Board meeting scheduled in Philadelphia during the week of April 22, 2002.

Also enclosed are Technical Comments to the National Remedy Review Board by the Settling PRP Group, dated February 12, 2002.

If you have any questions that you would like to have answered before the upcoming conference call, please call me at (215) 814-3228.

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National Remedy Review Board
Remedy Selection Briefing Package

Maryland Sand, Gravel and Stone Site, OU3
Elkton, MD

March 2002

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Site Information

Site Name, Location:	Maryland Sand, Gravel and Stone Site, Elkton, MD
CERCLIS ID#:	MDD980705164
Operable Unit (OU):	OU3, Soil, Sediment, Waste (Source Control)
Media Addressed by OU:	Soil, Sediments, Shallow Ground Water
Site Lead:	EPA
Site Type:	Former sand and gravel quarry that accepted industrial waste and F001-F005 RCRA solvent waste
Site Account No.:	T03W50102D0342BD03

Site Location, History and Enforcement Activities

The Maryland Sand, Gravel and Stone site is located north of U.S. Route 40 in Elkton, Cecil County, Maryland. The property consists of approximately 150 acres and is bounded to the south by a telephone transmission line right-of-way, to the north and west by residential properties along Marley Road and to the east by forested land and residential properties along Nottingham Road. (Figure 1 is an aerial photograph of the Site.)

The Maryland Sand, Gravel & Stone Company has owned the Site property since 1962 and formerly operated a sand and gravel quarry there. Quarrying operations were conducted in two different areas of the Site, known as the Eastern Excavated Area and the Western Excavated Area. About three acres in the Eastern Excavated Area reportedly were used for the disposal of waste processing water, still bottoms, sludge and drums of solid and semi-solid waste between 1969 and 1974. Three pits in the Eastern Excavated Area were used as surface impoundments where approximately 700,000 gallons of waste were deposited during the period of disposal operations. Some of the material that was placed at the Site would meet the definition of spent solvent wastes (F001-F005) under the Resource Conservation and Recovery Act (RCRA). As a result of the disposal activities, hazardous substances were released into Site soil, sediments, surface water and ground water. The ground water serves as a drinking water source for area residents.

In 1974, a high intensity chemical waste fire occurred at the Site; subsequently 200,000 gallons of liquid waste were removed from the Site and taken to the Kin Buc Landfill in Edison, New Jersey. The drums and sludges that remained following the removal of the liquid waste were buried onsite in excavated pits.

EPA conducted a Preliminary Assessment and Site Inspection in1982, and placed the Site on the National Priorities List (NPL) in September of 1984 because of the presence of organic compounds in ground water and surface water.

From 1984 to1985, EPA conducted a Phase I Remedial Investigation (RI) to investigate wastes and surface soil, surface water, sediment and ground water conditions at the Site, focusing primarily on the Eastern Excavated Area. The Phase I RI documented the presence of hazardous substances, including benzene, chlorinated solvents, 1,3- and 1,4-dichlorobenzene, cadmium and chromium, in shallow onsite ground water. Hazardous substances were also found in wastes, surface soils near waste sources, and surface water and sediments immediately adjacent to contaminant sources or ground water plumes.

In 1985, following the Phase I RI, EPA issued a Record of Decision (ROD) for Operable Unit One (OU1) at the Site. The OU1 ROD included measures to address the contamination in the shallow ground water, prevent the offsite migration of contaminants in leachate seeps and prevent trespassers from coming into contact with contaminated soils and wastes. It called for the removal of buried drums and the installation and maintenance of a perimeter fence to restrict access to the Eastern Excavated Area. The OU1 ROD also called for the recovery and onsite treatment of contaminated shallow ground water for a period up to five years. During this period the Agency planned to conduct additional characterization of the soils in the Eastern and Western Excavated Areas and the ground water in the deeper sand and bedrock aquifers, and to evaluate and undertake more comprehensive source control measures.

In 1988, 41 potentially responsible parties (PRPs) entered into a Consent Decree (CD) with EPA, agreeing to implement the OU1 ROD and reimburse EPA for related oversight costs. The Settlors under the CD installed a perimeter fence around the Eastern Excavated Area in 1989 and excavated and removed 1,199 drums from the area now known as the Buried Waste Area (BWA) in 1990. In addition, they installed a ground water recovery and treatment system to capture and treat contaminated ground water from the Upper Sand unit within the Eastern Excavated Area of the Site. This system, which includes three ground water recovery trenches and associated recovery wells, a soil-bentonite subsurface barrier wall, and an air stripper to remove volatile organic compounds (VOCs) from the recovered ground water, has operated continuously since February of 1996. (OU1 and OU2 remedial measures are shown in Figure 2.)

In 1986, 16 PRPs entered into an Administrative Order on Consent (AOC) with EPA under which they performed a Phase II Remedial Investigation and Feasibility Study (RI/FS). The Phase II, or Operable Unit Two (OU2), RI/FS was completed in 1990 and focused on the water bearing units beneath the Upper Sand unit and the evaluation of potential contaminant sources in the Western Excavated Area of the Site. In 1990, EPA issued a ROD for OU2 which calls for continued monitoring of ground water in the deeper water-bearing units (i.e., the Middle Sand unit, the Lower Sand unit and the Bedrock aquifer), including selected residential and institutional wells, and the recovery and treatment of ground water should contaminant concentrations exceed action levels which are specified in the OU2 ROD. A geophysical survey performed in the Western Excavated Area provided no evidence of waste disposal activities in that area of the Site. The analysis of soil samples obtained from depths up to 8 feet in the Western Excavated area showed no unacceptable risk for current or future use of the site and no need for further response actions in that area of the Site.

In 1992, an Amendment to the 1988 Consent Decree was entered by the United States District Court for the District of Maryland. Under the Amendment, 42 PRPs agreed to implement the OU2 ROD and reimburse EPA for related oversight costs. As required by the 1992 Amendment, the settling PRPs initiated the recovery and treatment of contaminated ground water in the Middle Sand unit in 1998 after it was determined that the contaminant concentrations in the ground water exceeded the action levels specified in the OU2 ROD. The monitoring of the ground water quality in the Middle Sand will continue until EPA, in consultation with the State, determines that the objectives of the monitoring program have been attained. The monitoring of ground water in the Lower Sand and Bedrock units was discontinued in 1998 following the evaluation of five years' sampling data which showed that no contaminants were present in the ground water at levels exceeding the action levels for ground water remediation specified in the OU2 ROD.

The final operable unit, OU3, addresses contaminated soil, sediment and wastes in the Eastern Excavated Area of the Site. In addition, because the OU1 ROD specifies interim measures, only, for the shallow Upper Sand ground water, OU3 includes final remedial measures for the contaminated shallow ground water in the Eastern Excavated Area. The settling PRPs completed the RI/FS for OU3 in ....2002.

SITE CHARACTERISTICS

The Eastern Excavated Area can be described as a plateau which has been significantly altered by past quarrying operations. To the north and northeast is a highwall which demarcates the boundary of the quarrying activities. To the west, south and portions of the east are the topographic boundaries of the plateau. The surrounding landscape is gently sloping woodland interspersed with open grassy areas. An unnamed tributary (the "western unnamed tributary") of Mill Creek flows through the Site in a southerly direction and enters a small pond and wetland area at the southwest corner of the Eastern Excavated Area. This tributary joins the "eastern unnamed tributary" to Mill Creek several hundred meters southeast of the Site, and the combined branches join Mill Creek proper which flows in a southerly direction to its confluence with Little Elk Creek. In the remainder of this document, "Site" shall mean the approximately 60-acre portion of the Maryland Sand, Gravel and Stone property contained within the existing fence, including the Eastern Excavated Area.

The landscape was left deeply gouged, mounded and terraced as a result of quarrying operations. Most rainfall in the Eastern Excavated Area is contained within the area, settling in depressions and small artificial basins. Some areas may percolate or dry up quickly while others may hold water for a time. Three formations exist within the Eastern Excavated Area that have been identified as ponds (Pond 1, Pond 2 and Pond 3) in many Site documents. The presence of surface water in these depression areas appears to be seasonal and rainfall dependent.

The lithologic units encountered at the Site have been referred to, from the top down, as the Upper Sand, Upper Clay, Middle Sand, Middle Clay, Lower Sand, Saprolite, and Bedrock units. The Upper Sand, Middle Sand, Lower Sand and Bedrock units are ground water bearing zones. (See Appendix A cross-sections.) The Upper Sand unit appears to be confined to the Eastern Excavated Area. Ground water in the Upper Sand is perched and flows towards the ground water recovery system trenches to the west, southwest and southeast outer boundaries of the plateau. The highest concentrations of ground water contaminants have been found in this unit due to the disposal of wastes directly into the Upper Sand.

The shallow soils in the Eastern Excavated Area are approximately 12 to 19 feet in thickness and consist of unconsolidated sands, gravels, silts and clays of the Potomac Group. The underlying silt and clay unit (the Upper Clay) is approximately 10 to 15 feet thick across the majority of the Site. However, the absence of this unit at one alignment boring near ground water recovery Trench S02 along the eastern boundary of the Site indicates that the Upper Clay is probably thinner in this area. Contaminated ground water has moved from the Upper Sand unit into the Middle Sand and underlying units by way of surface seeps, leakage through the Upper Clay unit, or migration through gaps in the Upper Clay unit. (Historical data showing toluene concentrations in the ground water of the Upper Sand unit and the ground water of the Lower Sand and Bedrock units is presented in Appendix B.)

From 1995 to 2001, the Settlors under the Amendment to the Consent Decree conducted site characterization work, human health and ecological risk assessments and additional data analysis necessary to evaluate and select the final response actions for the Site. The results of these activities and assessments are documented in the October 1997 *Soil Investigation Report*, the March 2001 *Supplemental Soil Delineation Data Report*, the May 2000 *Baseline Risk Assessment*, the August 2000 *Baseline Risk Assessment Addendum*, the March 2001 *Baseline Ecological Risk Assessment*, the January 2001 *Ground Water Biodegradation Screening Investigation Technical Memorandum*, the January 2001 *Remediation Technology Screening Technical Memorandum* and the (?) 2002 *Focused Feasibility Study*. These evaluations indicated that:

- Buried waste materials were visually observed in five of the eight areas evaluated during the OU3 Remedial Investigation: Pond 02, Pond 03, BWA, the Northern Depression Area (NDA), and the Soil Staging Area.

- Non-aqueous phase liquid (NAPL) was directly observed in the BWA and the NDA.

- The unsaturated and saturated soils of the Upper Sand unit are contaminated primarily with VOCs (e.g., benzene, chlorobenzene, 1,1-dichloroethene (1,1-DCE), 1,2-dichloroethane, tetrachloroethylene (PCE), toluene, 1,1,1-trichloroethane (TCA), trichloroethylene (TCE) and vinyl chloride). Metals (e.g., antimony, arsenic, barium, cadmium, chromium, lead, mercury, thallium and vanadium), pesticides (e.g., aldrin), polychlorinated biphenyls (PCBs) (e.g., Aroclor-1242) and semivolatile organic compounds (e.g., bis(2-chloroethyl)ether, bis(2-ethylhexyl)phthalate and 1,4-dichlorobenzene) are also present in the soil and sediments of the Upper Sand unit, although these contaminants are less widespread and some were found only infrequently.

- Contaminated soils or sediments in an area of Pond 2 known as Pond 2 Wet, the NDA and Seep 1 are considered to be "Direct Contact Principal Threat" material because the

WHAT IS A "PRINCIPAL THREAT"?

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water or air, or acts as a source for direct exposure. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur.

At the Maryland Sand, Gravel and Stone site, principal threat materials have been defined as soil, sediment and waste materials that pose a cancer risk of 1 X 10^{-3} (one additional cancer for every 1000 individuals exposed to Site contaminants) or higher, or have a hazard index (HI) of 100 or greater for current or potential future Site use. Soil, sediment and wastes at the Site which meet the definition of a principal threat based on direct contact with these materials are referred to as **Direct Contact Principal Threat** materials. Soil, sediment and wastes which have the potential to cause contaminant levels in ground water to pose a cancer risk of 1 X 10^{-3} or higher, or have a HI of 100 or greater, are referred to as **Ground Water Principal Threat** materials.

Soil, sediment and waste materials which, based on the direct contact and ground water exposure pathways, pose a cancer risk between one in 1000 (1 X 10^{-3}) and one in 10,000 (1 X 10^{-4}), or have a HI between 1and 100, are referred to, respectively, as **Direct Contact Low-level Threat** material and **Ground Water Low-level Threat** material. Any soil or waste containing lead levels greater than 400 milligrams/kilogram is also considered to be Direct Contact Low-level Threat material. However, contaminated materials located below the water table would not be considered as a direct contact threat.

chemicals of concern are present at concentrations that would pose a substantial risk should direct contact with this material occur during current or potential future site use. The excess carcinogenic risk to an individual exposed to these materials would be greater than one in a thousand (1 X 10^{-3}). The hazard index (HI) for non-cancer adverse health effects exceeds 100.

- Lead concentrations in the Pond 2 (including the Pond 2 Wet area), the NDA and Pond 3 exceed the EPA screening level of 400 mg/kg for lead in soil. However, the observed lead contamination was limited to a relatively small number of soil and sediment samples and does not appear to be widespread.

- The contaminated soils in the NDA, BWA Pond 2 and Pond 3 are considered to be "Ground Water Principal Threat" materials because the chemicals of concern are present at concentrations, calculated using the methods for determining site-specific soil screening levels (SSLs) outlined in EPA's *Soil Screening Guidance : User's Guide* (1996), that would impact ground water and pose a substantial risk to potential users of the ground water in the Upper Sand unit. The calculated excess lifetime cancer risk to an individual exposed to ground water contaminated by these materials would be greater than one in a thousand (1 X 10^{-3}). The HI for non-cancer adverse health effects would exceed 100.

- There is adequate to strong evidence that biodegradation of ground water contaminants is occurring naturally in portions of the plume that are downgradient from the contaminant source areas. Source control, in conjunction with the enhancement of the natural biodegradation processes, would substantially accelerate the removal of contaminants from ground water at the Site.

- Ecological receptors are unlikely to be adversely affected by contaminants in Site surface soils, sediments and surface water.

(The range of contaminant concentrations found in Site soils and sediments is presented in Appendix C.)

SCOPE AND ROLE OF THIS RESPONSE ACTION

This action, referred to as Operable Unit Three (OU3), will be the third and final response action for the Site. The first operable unit provided for the removal of buried drums from the Site, the installation of a perimeter fence to restrict access to the Site, and the installation of a ground water recovery and treatment system to capture and treat contaminated ground water from the Upper Sand unit within the Eastern Excavated Area until the final response measures are implemented. The second operable unit provides for the monitoring of ground water in the Middle Sand and underlying units and, should contaminant levels exceed action levels, the recovery and treatment of contaminated ground water (onsite) or the provision of point-of-use treatment (offsite). OU3 will provide for the remediation of source materials which constitute a principal threat at the Site, measures to enhance naturally occurring biodegradationof contaminants, and the continued recovery and treatment of the Upper Sand ground water until the cleanup levels are attained.

CURRENT AND POTENTIAL FUTURE LAND USE

With the exception of the ground water treatment plant and additional OU1 and OU2 ground water remediation components (e.g., ground water recovery trenches, subsurface barrier wall), the Site is undeveloped. However, the Site is zoned for residential use according to the zoning board of Cecil County, Maryland and the properties immediately adjacent to the Site are used for residential purposes or are zoned for residential use. On several occasions a developer who has expressed interest in acquiring the Site property for residential and commercial development has contacted Region III staff. Cecil County representatives also recently met with the State and EPA to discuss the Agency's plans for Site remediation and the County's potential interest in acquiring the Site property for open space. Land use within the surrounding area includes a mix of residential, commercial and light industrial activities. Approximately 600 people live within one mile of the Sand, Gravel and Stone site. The reasonably anticipated future land use for the Site is residential use.

Public water is not available within the vicinity of the Site and area residents, businesses, institutions and industries rely on the ground water of the Middle Sand unit and the underlying aquifers as a water source. In 1996, it became necessary to abandon and replace a nearby residential well screened in the Middle Sand unit due to Site-related contamination. During the past year, the PRPs have provided bottled water to the occupants of an additional residential property while confirmational sampling is performed, in accordance with the Consent Decree. (The locations of residential wells included in the OU2 monitoring program and recent analytical results for samples from those wells are included in Appendix D.) The ground water of the Upper Sand unit, where total VOC concentrations are on the order of 30-40 parts per million, is not used for residential purposes within the vicinity of the Site. (Analytical data for ground water samples recently collected from the Upper Sand unit and a figure showing sampling locations and potentiometric surface are presented in Appendix E.) This unit pinches out onsite and is unlikely to be used as a source of drinking water onsite. However, Site-related contaminants are also present in the ground water of the Middle Sand unit (on the order of 500 parts per billion total VOCs) and underlying aquifers which are used as sources of drinking water. (Analytical data for ground water samples recently collected from the Middle Sand unit and a figure showing sampling locations and potentiometric surface are presented in Appendix F.)

SUMMARY OF SITE RISKS

Human Health Risks

A *Baseline Risk Assessment* (BLRA) and a *Baseline Risk Assessment Addendum* (BLRA Addendum) were conducted in order to determine the current and potential future effects of contaminated soil on human health in the absence of further cleanup actions at the Site.

The BLRA considered the effects of incidental ingestion of, and dermal contact with, onsite surface soil and the inhalation of vapors emitted from the ground surface and the on-site air stripper. Because surface soil contamination in the small area of Pond 2 known as Pond 2 Wet was found to be substantially greater than the surface soil contamination in other areas of the Site, exposure to surface soil in this area was evaluated separately in the BLRA.

The exposure scenarios evaluated in the BLRA were based on three potential future Site uses: restricted use (operation and maintenance of the OU1 and OU2 remedial components, i.e., the current Site use); residential use; and industrial use (e.g., manufacturing or warehousing). Six different exposure scenarios were developed in order to estimate risks for the following populations: 1) on-site maintenance workers; 2) off-site residents; 3) potential on-site residents; 4) potential on-site industrial workers; 5) trespassing children who live off-site ("site-wide trespassing children"); and 6) children who trespass in the Pond 2 Wet area ("Pond 2 trespassing children"). It was assumed that each of these populations is exposed to airborne releases of VOCs from the ground surface and the on-site air stripper. With the exception of the off-site residents, it was assumed that each of these populations is also exposed to contaminated Site surface soils. Pond 2 trespassing children were assumed to be exposed to surface soils at Pond 2 Wet while playing in this area, and to surface soils on the remainder of the Site as hypothetical on-site residents. On-site maintenance workers, site-wide trespassing children, potential on-site residents and potential on-site industrial workers were assumed to be exposed to surface soils in all areas of the Site except the Pond 2 Wet area.

For the populations and exposure scenarios considered in the BLRA, the Pond 2 trespassing child was determined to be at the greatest risk of suffering adverse health effects due to exposure to Site contaminants. The excess lifetime cancer risk for the Pond 2 trespassing child is 3×10^{-3} (i.e., three extra cancers may occur for every 1000 people exposed to Site contaminants under the conditions described for the Pond 2 trespassing child in the BLRA). The chemicals that contribute most to this risk are aldrin (83 percent of total cancer risk) and PCE (8 percent of total cancer risk). The total HI for the Pond 2 trespassing child is 424. Several chemicals contribute to the total HI value, including aldrin (15 percent), PCBs (8 percent), and the metals antimony (24 percent), chromium (22 percent), cadmium (15 percent) and vanadium (7 percent). For both cancer and non-cancer health endpoints, dermal contact with soil in the Pond 2 Wet area accounted for more than 99 percent of the total risk to the Pond 2 trespassing child. Finally, lead concentrations in the surface soil of the Pond 2 Wet area exceed EPA's residential screening level of 400 mg/kg, indicating that there is a potential for adverse effects from exposure to lead in this area of the Site

For exposure to surface soil and air emissions outside the Pond 2 Wet area, the highest risks were calculated for an on-site resident. The excess lifetime cancer risk for an on-site resident is 8×10^{-6} (i.e., eight extra cancers may occur for every one million people exposed to Site contaminants under the conditions described for the on-site resident in the BLRA) which is within the risk range considered acceptable by EPA. The total HI for an on-site resident is 0.4. Therefore, the on-site resident exposed to contaminated surface soil and air emissions is not expected to suffer non-cancer adverse health effects.

The excess lifetime cancer risks for the other exposure scenarios evaluated in the BLRA were at or below 1×10^{-6}, and are considered to be acceptable. The total HI values for these exposure scenarios were all estimated to be below 0.1. Therefore, adverse non-cancer health effects are not expected.

Because any development of the Site property for residential or other use would entail earth moving activities that would expose contaminated subsurface soils, EPA requested that the PRPs submit an addendum to the BLRA in order to evaluate the potential future risks associated with exposure to contaminants in subsurface soils. The BLRA Addendum considered the effects of incidental ingestion of, and dermal contact with, contaminated soils up to ten feet deep which were assumed to be brought to the surface during construction activities. The BLRA Addendum also estimated the risks due to the inhalation of vapors which would be emitted from the contaminated subsurface soils once they were moved to the surface. Risks associated with exposure to soil contaminants in each of eight source areas identified during the Soil Investigation were calculated separately. Contaminated surface soil in the Pond 2 Wet area was not included in the assessment since this material was identified as presenting unacceptable risks in the BLRA.

The exposure scenarios evaluated in the BLRA Addendum were based on two potential future Site uses, residential use and industrial use. The BLRA Addendum indicated that risks for potential on-site residents were generally two to three times greater than risks for potential on-site industrial workers. The results for the on-site residential exposure scenario are summarized in this Proposed Plan.

Contaminated soils in the NDA, the BWA, Pond 2 and Pond 3 were shown to present unacceptable risks for potential future on-site residents under the exposure conditions considered in the BLRA Addendum. A summary of the risks and the contaminants of greatest concern is presented below.

The excess lifetime cancer risk due to exposure to soil in the NDA is 1×10^{-2} (i.e., one additional cancer may occur for every 100 individuals exposed). Exposure to PCE accounts for more than 90 percent of this total cancer risk, primarily through ingestion of soil. Other chemicals contributing to the total cancer risk in the NDA include TCE (4 percent of total cancer risk) 1,1-DCE (2 percent) and bis(2-chloroethyl)ether (1 percent). The total HI for exposure of an on-site resident to soil in the NDA is 183. Chlorobenzene accounts for most (54 percent) of the total HI value; however, several other organic compounds contribute to the non-cancer adverse health effects, including PCE (24 percent of the HI), TCA (7 percent), TCE (5 percent), toluene (4 percent) and benzene (4 percent).

The excess lifetime cancer risk due to exposure to soil in the BWA is 5×10^{-4} (i.e., five additional cancers may occur for every 10,000 individuals exposed). The chemicals that contribute most to this risk are 1,1-DCE (88 percent) and PCE (6 percent). The total HI is 2.2. Several chemicals contribute to the total HI value, including the organic compounds chlorobenzene (33 percent), benzene (14 percent), TCA (13 percent), PCE (7 percent), 1,2,4-trichlorobenzene (6 percent) and TCE (5 percent) and the metals iron (8 percent) and vanadium (7 percent).

The excess lifetime cancer risk associated with exposure to soil in Pond 2 (not including surface soil in Pond 2 Wet) is 2×10^{-4} (i.e., two additional cancers may occur for every 10,000 individuals exposed). The chemicals that contribute most to this risk are 1,1-DCE (42 percent), PCE (27 percent), vinyl chloride (13 percent) and methylene chloride (7 percent). The total HI for the soil in Pond 2 is 2.6. The organic chemicals chlorobenzene (16 percent), PCE (11 percent), and benzene (14 percent) and the metals thallium (29 percent), iron (10 percent), and vanadium (5 percent) account for most of the total HI value.

The total estimated HI for exposure by an on-site resident to soils in Pond 3 is 4.7. Thallium, with an estimated Hazard Quotient of 2.9, contributed most to non-cancer risk. The excess lifetime cancer risk due to exposure to soil in Pond 3 is 7×10^{-5}(i.e., 7 additional cancers may occur for every 100,000 individuals exposed) and is within the risk range that EPA finds acceptable.

Lead concentrations in subsurface soils at Pond 2, Pond 3 and the NDA exceed EPA's residential screening level of 400 mg/kg, indicating that there is a potential for adverse effects from exposure to lead in the future.

As documented in the OU1 and OU2 RODs, contaminants are present in ground water at levels which present unacceptable cancer and non-cancer risks. Risks from exposure to contaminated ground water were not reevaluated in OU3. However, the relationship between soil contamination and ground water quality was evaluated in the OU3 FFS (see Appendix G) and, as discussed below, soil action levels and soil treatment standards for the protection of ground water have been calculated in order to further define the remedial action objectives for OU3.

Ecological Risks

A screening level ecological risk assessment was conducted in order to identify potential direct and indirect (food web) toxicity to ecological receptors due to contaminants in surface soil, sediments and surface water. Contaminant concentrations in the Pond 2 Wet sediments exceeded toxicological benchmarks in the screening level ecological risk assessment and were not further evaluated because of the likely removal of the Pond 2 Wet sediments in order to address human health concerns. Site surface water and soils and sediments outside of the Pond 2 Wet area were subjected to toxicity testing in order to refine risk estimates. In addition, an earthworm bioaccumulation study was conducted in order to refine food-web modeling assumptions. The results of these studies, summarized in the *Baseline Ecological Risk Assessment* (BERA), indicate potential risk to small omnivorous mammals (e.g., shrews) as a result of exposure to selenium and vanadium (the hazard quotient is 1.7 for each) in Site surface soils. However, the concentrations of selenium and vanadium found in surface soil collected from the Site are similar to the concentrations of these metals present in the surface soil at nearby Elk Neck State Park and are not readily attributable to the disposal of waste at the Site. No direct or indirect toxicity was indicated for the other groups evaluated in the BERA (e.g., terrestrial and aquatic plants, organisms which live in soil or stream sediments, and fish).

REMEDIAL ACTION OBJECTIVES

The Remedial Action Objectives for the Site are to:

- protect human health for current and future Site use;
- address principal threats by treatment wherever practicable;
- prevent direct contact with contaminated soils or waste that would result in unacceptable levels of risk;
- mitigate further releases of hazardous substances to ground water;
- prevent exposure to contaminated ground water;
- restore ground water to its beneficial use;

- prevent the exposure of ecological receptors to the Pond 2 Wet sediments; and
- comply with applicable or relevant and appropriate requirements (ARARs).

In order to meet these objectives, the proposed action would target the following soils, sediments and waste materials for treatment or offsite disposal:[1]

- Ground Water Principal Threat material;
- Direct Contact Principal Threat material;
- Direct Contact Low-level Threat Material; and
- surface soils and sediments which pose a risk to ecological receptors.

These materials would be treated or removed in order to reduce risks for current and future Site use, including future residential use, to acceptable levels. Contaminated soils would be treated in order to:

- reduce the excess lifetime cancer risk associated with current and potential future direct contact with soil to one in one million (1×10^{-6});[2]
- reduce the HI for current and potential future direct contact with soil to 1;
- reduce the migration of contaminants from soils to ground water to levels that would not cause contaminant concentrations in the ground water of the Upper Sand unit to present an excess lifetime cancer risk greater than one in ten thousand (1×10^{-4}), result in a HI greater than 1, or exceed Maximum Contaminant Levels (MCLs) or non-zero Maximum Contaminant Level Goals (MCLGs) for public drinking water supplies; and
- comply with ARARs for the treatment of hazardous waste.

Based on the remedial action objectives, Preliminary Remediation Goals ("PRGs") (Table 1) for individual contaminants in Site soils were derived from the BLRA, the BLRA Addendum, and the methodology presented in EPA's *Soil Screening Guidance : User's Guide* (1996) for quantifying contaminant migration from soil to ground water (see Appendices C and D in the FFS). Because material which meets the PRGs for individual contaminants may not meet the cumulative risk standards specified above if multiple contaminants are present, the final cleanup

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[1]A relatively small volume of the material to be addressed contains constituents (e.g., metals, pesticides or PCBs) which would not be effectively treated by the proposed onsite treatment technology, or has physical characteristics that may prevent effective onsite treatment. This material would be disposed of offsite.

[2]It is unlikely that soils below the water table would be excavated during construction activities if the Site were developed for residential use in the future. Therefore, soils which would be placed below the water table following treatment would not be required to meet the 1×10^{-6} cancer risk standard for direct contact exposure. Soils which would be placed below the water table would be treated in order to reduce the excess lifetime cancer risk for direct contact with the soil to one in ten thousand (1×10^{-4}).

levels will be based on an assessment of the cumulative residual risk following the attainment of the PRGs. The cumulative risks associated with direct contact with the treated material, and the use of ground water which may be impacted by the treated material, would be calculated. If necessary, the soil and waste material would be further treated in order to ensure that the final remediation levels meet the cumulative risk standards.

In order to achieve the remedial action objectives for ground water, the proposed action would:

- continue the collection and treatment of the contaminated Upper Sand ground water which began for OU1 at the Site;
- employ engineered measures in order to increase the rate of contaminant biodegradation in the Upper Sand ground water; and
- restrict ground water use until the ground water cleanup levels are attained.

The recovery and treatment of the ground water in the Upper Sand unit would continue until the excess cancer risk associated with potential residential use of the ground water is reduced to one in ten thousand (1×10^{-4}) and the HI is reduced to 1. The enhancement of the natural biodegradation processes in the ground water of the Upper Sand unit would accelerate the rate at which progress is made toward attaining the cleanup levels for the shallow ground water. Temporary ground water use restrictions would prevent exposure to ground water that would result in unacceptable human health risks.

SUMMARY OF REMEDIAL ALTERNATIVES

The alternatives which were considered for the cleanup of contaminated media for OU3 at the Maryland Sand, Gravel and Stone site are discussed in detail in the *Focused Feasibility Study*. These remedial alternatives are summarized below and are numbered to correspond with the numbers in the *Focused Feasibility Study*. Figure 3 identifies the approximate areas which would be addressed by the remedial alternatives.

Alternative 1 - No Action

Estimated Capital Cost: $0
Estimated Present Worth Operation and Maintenance (O&M) Cost: $1,750,000
Estimated Present Worth Cost: $1,750,000

Regulations governing the Superfund program generally require that the "no action" alternative be evaluated in order to establish a baseline for comparison with the other remedial alternatives. This alternative includes no additional remedial actions beyond those already committed to under the existing Consent Decree for OU1 and OU2 at the Site. This alternative includes continued ground water monitoring for 30 years and periodic EPA site reviews (every five years).

Alternative 2 - Removal of Direct Contact Principal Threat Material, Installation of a Cap and Barrier Wall, and Expansion and Continued Operation of the Ground Water Recovery and Treatment System

Estimated Capital Cost: $7,651,000
Estimated Present Worth O&M Cost: $6,652,000
Estimated Present Worth Cost: $14,303,000

This alternative would include the excavation and off-site disposal of the Direct Contact Principal Threat material (approximately 500 cubic yards). The removal of this material would eliminate approximately two percent of the Ground Water Principal Threat volume. Alternative 2 would contain the remaining Ground Water Principal Threat material, the Ground Water Low-level Threat material and the Direct Contact Low-level Threat material with an approximately18-acre composite barrier (RCRA Subtitle C) cap in order to minimize the infiltration of precipitation and a subsurface barrier wall in order to restrict the lateral migration of ground water into the containment area. This alternative would also include the expansion of the existing shallow ground water interceptor trenches to connect trenches 1 and 2, and the continued collection and treatment of the Upper Sand ground water until the ground water cleanup levels are met throughout the Upper Sand unit, beyond the boundaries of the cap. Institutional controls would be put into place in order to prevent activities that would adversely affect the containment system or other components of the remedy, or which would result in unacceptable exposure risks. The area would be monitored in perpetuity to verify that the cap retains integrity and is not leaking and that the institutional controls remain effective.

Alternative 3a - Ex Situ Treatment (by LTTD) of Ground Water Principal Threat Material, Enhanced Biodegradation of Contaminants in Shallow Ground Water, and Expansion and Continued Operation of the Ground Water Recovery and Treatment System

Estimated Capital Cost: $13,926,000 - $15,090,000
Estimated Present Worth O&M Cost: $8,395,000
Estimated Present Worth Cost: $22,321,000 - $23,485,000

This alternative includes excavation, and on-site treatment by low temperature thermal desorption (LTTD), of the Ground Water Principal Threat material, Direct Contact Principal Threat material, and Direct Contact Low-level Threat material, which comprises approximately 30,000 cubic yards of soil and waste. Excavation activities would be conducted within a temporary enclosure if necessary in order to comply with State regulations governing emissions of toxic air pollutants. The excavated areas would be backfilled with treated soil, and the disturbed areas would be revegetated. Approximately 1000 cubic yards of material that contains constituents (e.g., metals, pesticides or PCBs) which would not be effectively treated by LTTD, or has physical characteristics that may prevent effective treatment by LTTD, would be disposed of offsite. The OU1 shallow ground water recovery trench system would be expanded by connecting existing trenches 1 and 2. Inorganic nutrients, organic carbon and/or microbial cultures would be added to the saturated zone of the Upper Sand unit in order to enhance the contaminant biodegradation processes which are occurring naturally at the Site. Shallow ground would continue to be collected and treated until the ground water cleanup levels are attained throughout the Upper Sand unit. Temporary institutional controls would be put into place in order to prevent activities that would adversely affect the components of the ground water recovery system and in order to prevent the use of ground water for consumption and/or showering until the ground water cleanup levels are attained. In the event of future Site development, vapor abatement equipment would be installed in any building which may be subject to unacceptable indoor air quality due to contaminants present in Site soils and ground water.

Alternative 3b - In Situ Treatment of Ground Water Principal Threat Material, Enhanced Biodegradation of Contaminants in Shallow Ground Water, and Expansion and Continued Operation of the Ground Water Recovery and Treatment System

Estimated Capital Cost: $13,976,000
Estimated Present Worth O&M Cost: $8,395,000
Estimated Present Worth Cost: $22,371,000

This alternative includes the *in situ* treatment of the Ground Water Principal Threat material, Direct Contact Principal Threat material, and Direct Contact Low-level Threat material, which comprises approximately 30,000 cubic yards of soil and waste. This material would be treated either by chemical oxidation with shallow soil mixing, or thermally by resistive heating or steam injection and recovery. The selection of the technology for *in situ* treatment would be made during the design phase after the completion of laboratory and pilot scale studies. Approximately 1000 cubic yards of material that would not be effectively treated onsite because of the properties of the contaminants or the soil matrix would be disposed of offsite. The OU1 shallow ground water recovery trench system would be expanded by connecting existing trenches 1 and 2. Inorganic nutrients, organic carbon and/or microbial cultures would be added to the saturated zone of the Upper Sand unit in order to enhance the contaminant biodegradation processes which are occurring naturally at the Site. Shallow ground would continue to be collected and treated until the ground water cleanup levels are attained throughout the Upper Sand unit. Temporary institutional controls would be put into place in order to prevent activities that would adversely affect the components of the ground water recovery system and in order to prevent the use of ground water for consumption and/or showering until the ground water cleanup levels are attained. In the event of future Site development, vapor abatement equipment would be installed in any building which may be subject to unacceptable indoor air quality due to contaminants present in Site soils and ground water.

Alternative 3c - Ex Situ Treatment (by LTTD) of Ground Water Principal Threat Material above the Water Table, In Situ Treatment (by Chemical Oxidation) of Ground Water Principal Threat Material Below the Water Table, Enhanced Biodegradation of Contaminants in Shallow Ground Water, and Expansion and Continued Operation of the Ground Water Recovery and Treatment System

Estimated Capital Cost: $11,773,000 - $12,844,000
Estimated Present Worth O&M Cost: $8,395,000
Estimated Present Worth Cost: $20,168,000 - $21,239,000

This alternative combines the components of Alternatives 3a and 3b to include excavation and onsite LTTD of the Ground Water Principal Threat material, the Direct Contact Principal Threat material and the Direct Contact Low-level Threat material located above the water table (approximately 23,000 cubic yards of soil and waste), and *in situ* chemical oxidation of the Ground Water Principal Threat material below the water table (approximately 7,000 cubic yards of soil and waste). Excavation activities would be conducted within a temporary enclosure if necessary in order to comply with State regulations governing emissions of toxic air pollutants. Approximately 1000 cubic yards of material which would not be effectively treated onsite because of the properties of the contaminants or the soil matrix would be disposed of offsite. The OU1 shallow ground water recovery trench system would be expanded by connecting existing trenches 1 and 2. Inorganic nutrients, organic carbon and/or microbial cultures would be added to the saturated zone of the Upper Sand unit in order to enhance the contaminant biodegradation processes which are occurring naturally at the Site. Shallow ground would continue to be collected and treated until the ground water cleanup levels are attained throughout the Upper Sand unit. Temporary institutional controls would be put into place in order to prevent activities that would adversely affect the components of the ground water recovery system and in order to prevent the use of ground water for consumption and/or showering until the ground water cleanup levels are attained. In the event of future Site development, vapor abatement equipment would be installed in any building which may be subject to unacceptable indoor air quality due to contaminants present in Site soils and ground water.

Alternative 4a - Ex Situ Treatment (by LTTD) of Ground Water Principal Threat Material, Installation of a Cap and Barrier Wall, and Expansion and Continued Operation of the Ground Water Recovery and Treatment System

Estimated Capital Cost: $18,620,000 - $19,784,000
Estimated Present Worth O&M Cost: $6,652,000
Estimated Present Worth Cost: $25,272,000 - $26,436,000

Alternative 4a includes the excavation, onsite treatment by LTTD, and backfilling of essentially the same material (approximately 30,000 cubic yards of soil and waste) that would be addressed in this manner by Alternative 3a.[3] Approximately 1000 cubic yards of material which would not be effectively treated onsite would be disposed of offsite, as in Alternative 3a. This alternative differs from Alternative 3a in that it does not utilize and enhance the contaminant biodegradation processes that are naturally occurring in the ground water of the Upper Sand unit. Instead, Alternative 4a would contain the Ground Water Low-level Threat area with an approximately18-acre composite barrier (RCRA Subtitle C) cap in order to minimize the infiltration of precipitation and a subsurface barrier wall in order to restrict the lateral migration of ground water into the containment area. This alternative would include the expansion of the existing shallow ground water interceptor trenches to connect trenches 1 and 2, and the continued collection and treatment of the Upper Sand ground water until the ground water cleanup levels are met throughout the area of attainment. Institutional controls would be put into place in order to prevent activities that would adversely affect the containment system or other components of the remedy, or which would result in unacceptable exposure risks. The area would be monitored in perpetuity to verify that the cap retains integrity and is not leaking and that the institutional controls remain effective.

Alternative 4b - In Situ Treatment of Ground Water Principal Threat Material, Installation of a Cap and Barrier Wall, and Expansion and Continued Operation of the Ground Water Recovery and Treatment System

Estimated Capital Cost: $18,294,000
Estimated Present Worth O&M Cost: $6,652,000
Estimated Present Worth Cost: $24,946,000

Alternative 4b includes the *in situ* chemical oxidation or thermal treatment of essentially the same material (approximately 30,000 cubic yards of soil and waste) that would be addressed in this manner by Alternative 3b.[3] Approximately 1000 cubic yards of material which would not be effectively treated onsite would be disposed of offsite as in Alternative 3b. This alternative differs from Alternative 3b in that it does not utilize and enhance the contaminant biodegradation processes that are naturally occurring in the ground water of the Upper Sand unit. Instead, Alternative 4b would contain the Ground Water Low-level Threat area with an approximately18-acre composite barrier (RCRA Subtitle C) cap in order to minimize the infiltration of precipitation and a subsurface barrier wall in order to restrict the lateral migration of ground water into the containment area. This alternative would include the expansion of the existing

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[3]An evaluation based on the available data (see Appendix E of the *Focused Feasibility Study)* suggests that soils and waste materials which constitute a Direct Contact Low-level Threat are contained within the Ground Water Principal Threat volume. Alternatives 4a and 4b call for the excavation and onsite treatment of principal threat material, only, and, unlike Alternatives 3a and 3b, would not require the excavation and treatment of any Direct Contact Low-level threat material that exists outside the Ground Water Principal Threat area. Alternatives 4a and 4b would prevent exposure to any such material through containment measures and permanent institutional controls.

shallow ground water interceptor trenches to connect trenches 1 and 2, and the continued collection and treatment of the Upper Sand ground water until the ground water cleanup levels are met throughout the area of attainment. Institutional controls would be put into place in order to prevent activities that would adversely affect the containment system or other components of the remedy, or which would result in unacceptable exposure risks. The area would be monitored in perpetuity to verify that the cap retains integrity and is not leaking and that the institutional controls remain effective.

Alternative 5 - Ex Situ Treatment of Ground Water Principal Threat and Low-level Threat Material, and Expansion and Continued Operation of the Ground Water Recovery and Treatment System

Estimated Capital Cost: $70,529,000 - $71,736,000
Estimated Present Worth O&M Cost: $6,213,000
Estimated Present Worth Cost: $76,742,000 - $77,949,000

This alternative is essentially identical to Alternative 3a, except that this alternative includes the excavation and *ex situ* treatment of a much larger volume of material (i.e., the Ground Water Low-level Threat material, in addition to the Ground Water Principal Threat material, Direct Contact Principal Threat material and Direct Contact Low-level Threat material), and does not include a component of enhanced biodegradation of the contaminants in the shallow ground water. Specifically, this alternative includes the excavation and onsite LTTD of approximately 340,000 cubic yards of soil and waste materials. Excavation of the Ground Water Principal Threat material would be conducted within a temporary enclosure if necessary in order to comply with State regulations governing emissions of toxic air pollutants. The excavated areas would be backfilled with treated soil, and the disturbed areas would be revegetated. Approximately 1000 cubic yards of material that would not be effectively treated by LTTD would be disposed of offsite. The OU1 shallow ground water recovery trench system would be expanded by connecting existing trenches 1 and 2. Shallow ground would continue to be collected and treated until the ground water cleanup levels are attained throughout the Upper Sand unit. Temporary institutional controls would be put into place in order to prevent activities that would adversely affect the components of the ground water recovery system and in order to prevent the use of ground water for consumption and/or showering until the ground water cleanup levels are attained.

EVALUATION OF ALTERNATIVES

Nine criteria are used to evaluate the different remediation alternatives individually and against each other in order to select a remedy. This section of the Proposed Plan profiles the relative performance of each alternative against the nine criteria, noting how it compares with the other options under consideration. The nine evaluation criteria are discussed below. The detailed evaluation of remedial alternatives can be found in the *Focused Feasibility Study*. A summary is provided in Table 2.

Overall Protection of Human Health and the Environment

A primary requirement of CERCLA is that the selected remedial action be protective of human health and the environment. A remedy is protective if it reduces current and potential risks associated with each exposure pathway at a Site to acceptable levels.

Alternative 1 (No Action) contains no provisions for preventing exposure to contamination, and is not protective of human health and the environment. Because Alternative 1 does not satisfy the threshold criterion of protectiveness it will not be considered further in this analysis.

Alternatives 2 through 5 would provide adequate protection of human health and the environment by eliminating, reducing or controlling risk through treatment, engineering controls and/or institutional controls. Each of these alternatives would prevent exposure to contaminated ground water through the institution of ground water use restrictions. In addition, they would provide for the continued collection and treatment of ground water in the Upper Sand unit which would diminish the migration of contaminants within the Upper Sand unit, and from the Upper Sand unit into the Middle Sand unit and underlying water-bearing zones. The continued collection of the shallow ground water would also prevent the re-emergence of surface water seeps which existed prior to the implementation of ground water recovery operations at the Site.

Alternative 2 would provide protection against direct contact risk through containment of the majority of the impacted material and the institution of permanent land use restrictions, as well as the excavation and offsite disposal or treatment of the Direct Contact Principal Threat material. The cap and barrier wall provided by Alternative 2 would also reduce the migration of contaminants from soil to ground water by minimizing the infiltration of precipitation and inhibiting the lateral movement of ground water into the area of impacted soils. Alternatives 3a, 3b and 3c would provide protection against direct contact risk through onsite treatment[4] of the Direct Contact Low-level Threat material and Direct Contact Principal Threat material in order to achieve acceptable risk-based levels. These alternatives would reduce the migration of contaminants from soil and waste material into ground water through the onsite treatment of the Ground Water Principal Threat material which constitutes the most substantial continuing source of ground water contamination at the Site. Alternatives 3a, 3b and 3c would accelerate the rate at which progress is made toward the attainment of cleanup levels in the shallow ground water by promoting naturally occurring contaminant biodegradation processes at the Site. Alternatives 4a and 4b would provide protection against direct contact risk through a combination of onsite treatment[4] of the Direct Contact Principal Threat material, treatment or containment of the Direct Contact Low-level Threat material and the institution of permanent land use restrictions. These alternatives would reduce the migration of contaminants from soil and waste material into ground water through the onsite treatment of the Ground Water Principal Threat material and containment of the Ground Water Low-level Threat material. Alternative 5 would provide

[4]Direct Contact Principal Threat material and Direct Contact Low-level Threat material which could not be effectively treated onsite would be excavated for offsite disposal or treatment.

protection against direct contact risk through onsite treatment[4] of the Direct Contact Low-level Threat material and the Direct Contact Principal Threat material in order to achieve acceptable risk-based levels. This alternative would reduce the migration of contaminants from soil and waste material into ground water through the onsite treatment of the Ground water Low-level Threat material, in addition to the Ground Water Principal Threat material.

Alternatives 2 through 5 would protect ecological receptors at the Site by excavation and offsite disposal or treatment of the Pond 2 Wet sediments which were found to present an unacceptable risk to ecological receptors.

Compliance with ARARs

This criterion addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements (ARARs) of federal and state environmental laws and/or will provide grounds for invoking a waiver.

The MCLs and non-zero MCLGs for public drinking water supplies established under the Safe Drinking Water Act are considered to be relevant and appropriate standards for ground water cleanup under the Superfund program. The concentrations of several contaminants in the ground water of the Upper Sand unit exceed MCLs. Each of Alternatives 2 through 5 would achieve MCLs and non-zero MCLGs for ground water contaminants within the area of attainment over time.

Alternatives 2 through 5 would result in the continued release of VOC emissions from the onsite air stripper and would comply with State regulations governing air emissions. Alternatives 2 through 5 also entail the onsite discharge of treated ground water to the western unnamed tributary of Mill Creek. In order to support the designated uses of Mill Creek, the discharge of treated ground water in each of these alternatives would result in in-stream compliance with MCLs and non-zero MCLGs, State water quality standards, and federal ambient water quality criteria for the protection of aquatic life.

The treatment of soil and waste materials in Alternatives 3a through 5 would result in the generation of residual wastes. Onsite handling of residual wastes would comply with State standards applicable to generators and transporters of hazardous waste. Alternatives 3a, 3c, 4a and 5 involve the excavation, onsite treatment and backfilling of soil containing RCRA hazardous waste. The soil would be treated in order to meet RCRA Universal Treatment Standards for soils in compliance with federal land disposal restrictions. The federal land disposal restrictions would also apply to any offsite disposal of contaminated media or residual wastes from the Site. Any onsite treatment or storage of hazardous wastes in Alternatives 3a through 5 would comply with State standards for owners and operators of hazardous waste treatment, storage and disposal facilities.

The onsite thermal treatment of soil and waste material under Alternatives 3a through 5 would comply with federal air emission standards for process vents and equipment leaks. The treatment by LTTD of soil and waste material in Alternatives 3a, 3c, 4a and 5 would also comply with federal requirements for thermal treatment of hazardous waste (40 C.F.R. Part 264, Subpart X).

The capping of contaminated soil and waste material under Alternatives 2, 4a and 4b would comply with State closure requirements for hazardous waste landfills.

Long-term Effectiveness and Permanence

The evaluation of alternatives under this criterion considers the ability of an alternative to maintain protection of human health and the environment over time. The evaluation takes into account the residual risk remaining from untreated waste at the conclusion of remedial activities as well as the adequacy and reliability of containment systems and institutional controls.

Alternatives 2 through 5 include the excavation and offsite disposal of the Direct Contact Principal Threat material and would permanently eliminate the risk that would result from exposure to this material from the Site.[5]

Alternative 2 would use containment (cap and subsurface barrier wall) to prevent exposure to Direct Contact Low-level Threat material and to minimize the migration of contaminants from the Ground Water Principal Threat material and the Ground Water Low-level Threat material into ground water. A properly installed and maintained cap and barrier wall would provide adequate long-term isolation of materials which present a relatively low-level threat. However, containment measures may be less effective in controlling materials that are highly toxic or highly mobile, including the NAPL which is present at the Site. This alternative would require permanent land use restrictions and perpetual maintenance activities in order to ensure the long-term effectiveness and permanence of the containment system.

Alternatives 3a through 5 would provide greater long-term effectiveness and permanence than Alternative 2 through the onsite treatment of 30,000 to 340,000 cubic yards of soil and waste material in order to effect a substantial and permanent reduction in onsite contaminant concentrations. The treatment of the Ground Water Principal Threat material under Alternatives 3a through 3c would permanently eliminate this material as a source of unacceptable levels of ground water contamination in the Upper Sand unit. The treatment of the Direct Contact Low-level Threat material under each of these alternatives would permanently remove contaminants from the Site and eliminate unacceptable risks due to direct contact with Site soils. However, contaminant concentrations in the untreated soils (e.g., the Ground Water Low-level Threat material) may present a source of unacceptable indoor air quality should the Site be developed for residential use in the future, and engineering controls would be required in order to reduce any such risks to acceptable levels. Alternatives 3a through 3c would also enhance the rate of naturally occurring contaminant biodegradation processes in shallow ground water. These

[5]Any Direct Contact Principal Threat material that is amenable to onsite treatment may be treated onsite under Alternatives 3a through 5.

processes are already resulting in the removal, through destruction, of the contaminants in the ground water beyond the source areas. Alternatives 4a and 4b utilize a combination of treatment to permanently remove contaminants from the Ground Water Principal Threat material and containment as a control for the Ground Water Low-level Threat material and remaining Direct Contact Low-level Threat material. Because Alternatives 4a and 4b would utilize containment to control the residual risks posed by the treated material, the risk-based treatment standards for soil and waste materials under these alternatives are less stringent than the risk-based treatment standards for these materials under Alternatives 3a through 3c. Alternatives 4a and 4b would require permanent land use restrictions and perpetual maintenance activities in order to ensure the long-term effectiveness and permanence of the containment system. Alternative 5 provides the highest degree of contaminant removal from the Site through the active treatment of both the Ground Water Principal Threat material and the Ground Water Low-level Threat material to acceptable risk-based standards. The residual risks posed by the treated soil and waste material for each of Alternatives 3a through 5 are presented in Table 2-10 of the *Focused Feasibility Study* (see Appendix H).

Alternatives 2 though 5 would reduce the risks that would result from the use of ground water located within the area of attainment to acceptable levels through the collection and treatment of ground water. Under Alternatives 3a through 3c and Alternative 5, the ground water cleanup levels would be attained throughout the Upper Sand unit. Restrictions on ground water use could be eliminated once the ground water cleanup levels were achieved for each of these alternatives. The ground water cleanup levels would be attained within the Upper Sand unit, beyond the boundaries of the cap system, under Alternatives 2, 4a and 4b. These alternatives would require permanent restrictions on the use of ground water within the containment system in order to prevent unacceptable exposure risks.

Reduction of Toxicity, Mobility or Volume of Contaminants through Treatment

This evaluation criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce the toxicity, mobility, or volume of the hazardous substances as their principal element. This preference is satisfied when treatment is used to reduce the principal threats at a site.

Alternative 2 would provide offsite disposal or treatment of the Direct Contact Principal Threat material (approximately 500 cubic yards of soil, sediment and waste material). This Alternative calls for containment of the more substantial Ground Water Principal Threat volume (approximately 30,000 cubic yards of soil and waste material) and, therefore, it would not achieve a significant reduction of toxicity, mobility or volume of hazardous substances in Site soils through treatment.

Alternatives 3a through 5 would each provide onsite treatment of an estimated 30,000 cubic yards of Ground Water Principal Threat material in addition to offsite disposal or treatment of the Direct Contact Principal Threat material. In addition, Alternative 5 would treat an estimated 310,000 cubic yards of Ground Water Low-level Threat material. Those alternatives which provide thermal treatment of contaminated soil and waste material (Alternatives 3a, 3c, 4a, 5 and, possibly, 3b and 4b) would include the offsite incineration or disposal of hazardous substances removed from the soil and waste materials in accordance with RCRA.[6] The *in situ* chemical oxidation of contaminated soil and waste material under Alternatives 3b, 3c and 4b would result in the onsite destruction of the contaminants of concern. Alternatives 4a and 4b include containment of the treated materials and, therefore, these alternatives are required to provide a lower degree of toxicity reduction through treatment than Alternatives 3a, 3b, 3c and 5 which do not include a containment component. Alternatives 3a, 3c, 4a and 5, which provide treatment by LTTD,[7] would meet the cumulative risk standards, presented in Table 2-10 of the *Focused Feasibility Study,* for the material treated via LTTD. Uncertainty exists regarding the ability of the *in-situ* treatment technologies (components of Alternatives 3b, 3c and 4b) to achieve treatment standards. During laboratory treatability studies, chemical oxidation of Site soils yielded only modest reductions in the concentrations of certain contaminants of concern. Those alternatives which involve *in situ* treatment of soil and waste would likely provide a lesser degree of risk and toxicity reduction than those alternatives which provide treatment through LTTD.

Each of Alternatives 2 through 5 provide for the continued collection of contaminated ground water and would reduce the toxicity and volume of contaminated ground water at the Site through treatment, although VOCs in ground water would ultimately be transferred to the ambient air. Alternatives 3a through 3c and 5 would provide the greatest reduction of contaminant mass at the Site through the collection and treatment of ground water because, in contrast to the containment remedies, these alternatives would allow continued flushing of residual contaminants from soil to ground water and would allow, or enhance, naturally occurring contaminant biodegradation processes at the Site.

Short-term Effectiveness

This evaluation criterion addresses the effects of the alternative during the construction and implementation phase until remedial action objectives are met. It considers risk to the community and onsite workers and available mitigation measures, as well as the time frame for the attainment of the response objectives.

The short-term risks associated with the implementation of Alternative 2 are minimal because of the limited scope of excavation activities. Alternatives 3a, 3c, 4a and 5 involve the excavation and onsite treatment of a substantial volume of contaminated soil and waste material and thus present potential short-term exposure risks to onsite workers and the local community. Air monitoring would be conducted and, if necessary, engineering controls would be implemented in

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[6] A portion of the treatment residuals may be destroyed onsite (e.g., using catalytic oxidation) in accordance with federal and State regulations, if determined to be cost-effective.

[7] Alternatives 3a, 3c and 5 include a provision for High Temperature Thermal Desorption to treat a portion of the material, if necessary in order to meet treatment objectives.

order to mitigate risks and comply with State regulations governing emissions of toxic air pollutants. Excavation activities would be conducted within a temporary enclosure if necessary in order to comply with State air quality regulations. Work within an enclosure would increase the physical hazards to onsite workers. The short-term risk to onsite workers and the local community associated with Alternatives 3b and 4b would depend on the *in situ* treatment technology employed. *In situ* chemical oxidation would be expected to present minimal and controllable short-term exposure risks. The oxidation process would destroy contaminants in place and minimize volatilization of the contaminants of concern. The *in situ* thermal processes would result in the volatilization and recovery of contaminants. Air quality monitoring would be conducted and, if necessary, additional emission controls would be implemented in order to comply with State air quality regulations. Alternatives 2 through 5 also entail continued emissions of VOCs from the air stripper to ambient air. Potential uncontrolled emissions from the air stripper were evaluated during the design of the ground water treatment plant and were determined to comply with State air quality regulations. In addition, the OU3 BLRA indicates that there are no unacceptable risks associated with exposure to emissions from the air stripper.

Alternative 2 would provide an immediate reduction in direct contact risk through the offsite disposal or treatment of the Direct Contact Principal Threat material, the containment of the Direct Contact Low-level Threat material and the institution of land use restrictions in order to prevent unacceptable exposure risks. The excavation and offsite disposal of material and the installation of a cap and barrier wall could be accomplished within 7 to 10 months. However, the ability of Alternative 2 to reliably control the migration of contaminants from the Ground Water Principal Threat material into ground water is uncertain. Alternatives 3a through 5 would provide immediate benefits (mitigation of direct contact risk and reduction in the migration of contaminants from soil and waste materials to ground water) through treatment of the Ground Water Principal Threat material. Alternatives 4a and 4b would be expected to achieve cleanup standards for ground water within a relatively short time frame. However, the ground water cleanup standards would be achieved outside the containment zone, only. Under Alternatives 3a, 3b and 3c, additional time would be required in order to achieve ground water cleanup standards through the enhancement of natural biodegradation processes. However, the ground water cleanup standards would ultimately be achieved throughout the Upper Sand unit. The excavation and treatment of contaminated materials and the backfilling of treated materials under Alternative 3a could be accomplished within 10 to 12 months. The installation of a cap and barrier wall, as provided by Alternative 4a, would add 4 to 6 months to the construction phase of the project. Alternative 5 would provide treatment of the Ground Water Low-level Threat material, in addition to the Ground Water Principal Threat material, which would provide an additional immediate reduction in the migration of contaminants into ground water. Alternative 5 targets a large volume of material for treatment and, therefore, 2 to 3 years would be required in order to excavate, treat and backfill affected materials.

Implementability

The evaluation of alternatives under this criterion considers the technical and administrative feasibility of implementing an alternative and the availability of services and materials required during implementation.

Construction of the subsurface barrier wall and cap, and extension of the ground water collection trench would be easily accomplished using conventional methods and materials for each of Alternatives 2 through 5. Alternatives 3a through 5 would be more difficult to implement than Alternative 2. These alternatives involve onsite treatment of soil and waste material, which would require additional controls in order to minimize VOC exposure to onsite workers and the local community. Alternatives 3a, 3c, 4a and 5, which include excavation and onsite treatment of soil, may require a containment structure to control and treat soil vapor emissions. Alternatives 3a and 4a would be slightly more difficult to implement than Alternatives 3b and 3c due to the need to use shoring and dewatering. Shoring and dewatering are also components of Alternative 5. Alternative 5 would present the greatest implementation difficulties due to the need to excavate all of the Ground Water Low-level Threat material above and below the water table. Uncertainty exists regarding the ability of the *in situ* treatment technologies (components of Alternatives 3b, 3c and 4b) to achieve treatment standards and the alternatives which include these technologies would require treatability studies and pilot studies before they could be considered for full-scale application at the Site.

The remaining components of Alternatives 2 through 5 would not present any major implementation difficulties. Ground water monitoring would be performed using common practices. Mechanisms exist within the State and County governments to institute and enforce ground water use restrictions. Future use of the Site property could be effectively controlled through the use of an easement because the owner of the land is subject to regulation under CERCLA.

Cost

The comparison of costs among the alternatives is straightforward. Among the remedial alternatives which meet the threshold criteria, Alternative 2 is significantly less costly than the other alternatives. Alternative 2 relies on containment as the primary means for reducing risk and does not use treatment to address principal threats wherever practicable. Alternatives 3a through 3c each entail the onsite treatment of Ground Water Principal Threat material and the present worth costs for these alternatives are comparable. Alternatives 4a and 4b include the installation of a cap and barrier wall, in addition to the onsite treatment of the Ground Water Principal Threat material and, therefore, these alternatives are somewhat more costly than Alternatives 3a, 3b, and 3c. Alternative 5 provides for excavation and onsite treatment of approximately ten times the volume of soil and waste material that would be treated under Alternatives 3a through 4b. Alternative 5 is substantially more costly than the other remedial alternatives. However, it does not offer any significant advantages in risk reduction over Alternatives 3a through 4b. The capital costs for Alternatives 3a, 3c, 4a and 5 would depend on whether or not excavation activities were conducted within an enclosure. The costs for each of these alternatives, both with and without an enclosure, are provided above in the description of the alternatives.

State Acceptance

The State of Maryland Department of the Environment (MDE) has reviewed and commented on this Proposed Plan and all documents supporting this Proposed Plan. MDE acceptance of the preferred alternative will be evaluated after the public comment period and will be described in the Record of Decision.

Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the Record of Decision.

SUMMARY OF THE PREFERRED ALTERNATIVE

Alternative 3a, *Ex Situ* Treatment (by LTTD) of Ground Water Principal Threat Material, Enhanced Biodegradation of Contaminants in Shallow Ground Water, and Expansion and Continued Operation of the Ground Water Recovery and Treatment System, is the preferred remedial alternative for OU3 at the Maryland Sand, Gravel and Stone site.

Alternative 3a is the preferred alternative because it would provide permanent and substantial risk reduction through the treatment of source materials which constitute principal threats and would allow the Site property to be used for residential development which is the reasonably anticipated future land use for the Site. *Ex situ* LTTD is a proven technology which is capable of achieving the treatment standards necessary in order to meet the remedial action objectives for the Site. The enhancement of the contaminant biodegradation processes which are naturally occurring in the ground water under Alternative 3a would result in additional removal of contaminants from the Site and would ultimately lead to the attainment of the ground water cleanup standards throughout the Upper Sand unit. The preferred alternative would mitigate releases of hazardous substances to ground water, prevent exposure to contaminated ground water and restore ground water to its beneficial uses.

Based on information available at this time, EPA believes the preferred alternative would be protective of human health and the environment, would comply with ARARs, would be cost-effective, and would utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. Because it would treat the source materials constituting principal threats, the remedy also would meet the statutory preference for the selection of a remedy that involves treatment as a principal element.

Figures

Figure 1
Aerial Photo of Site
Maryland Sand, Gravel, and Stone Site
Elkton, Maryland

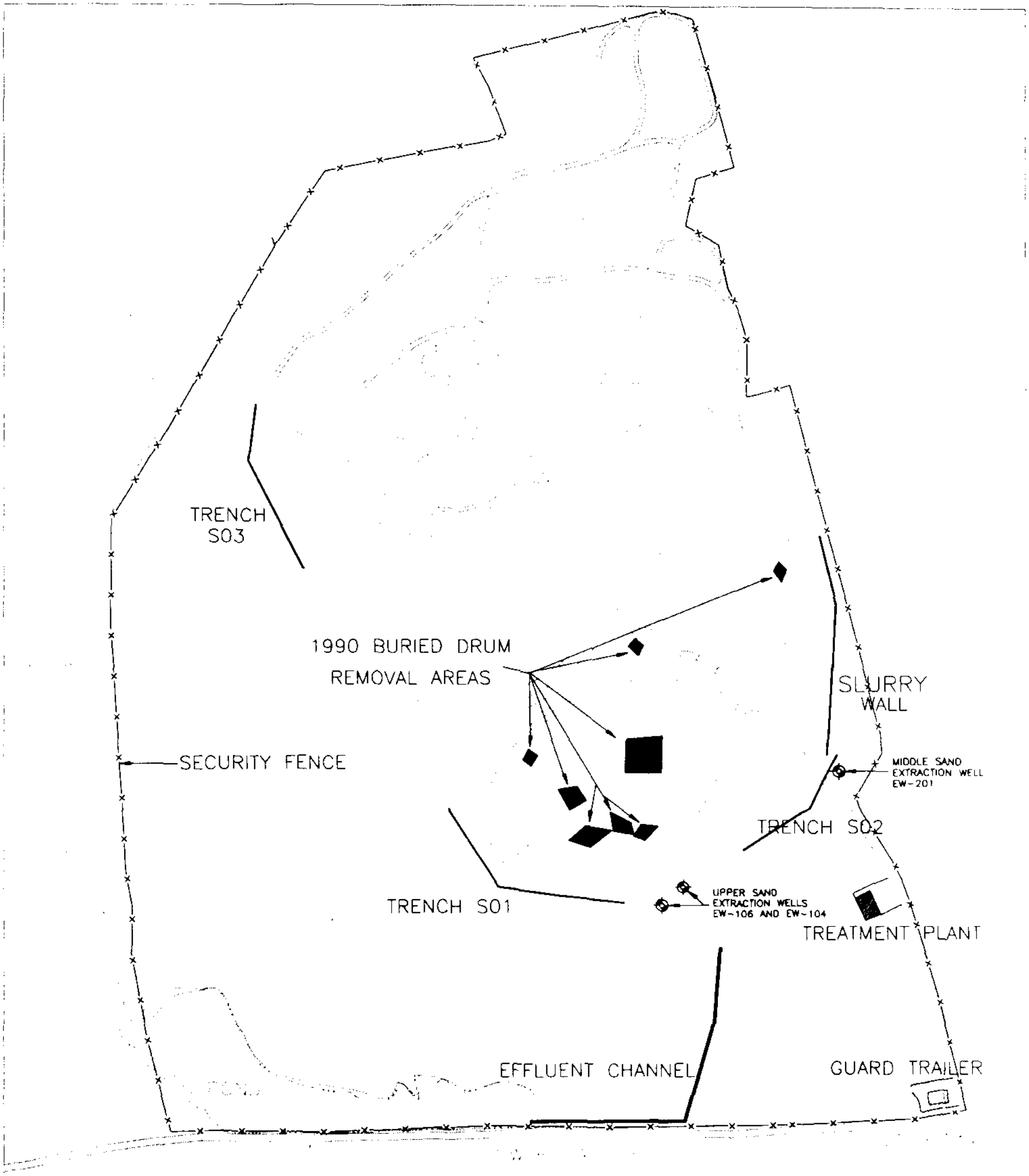
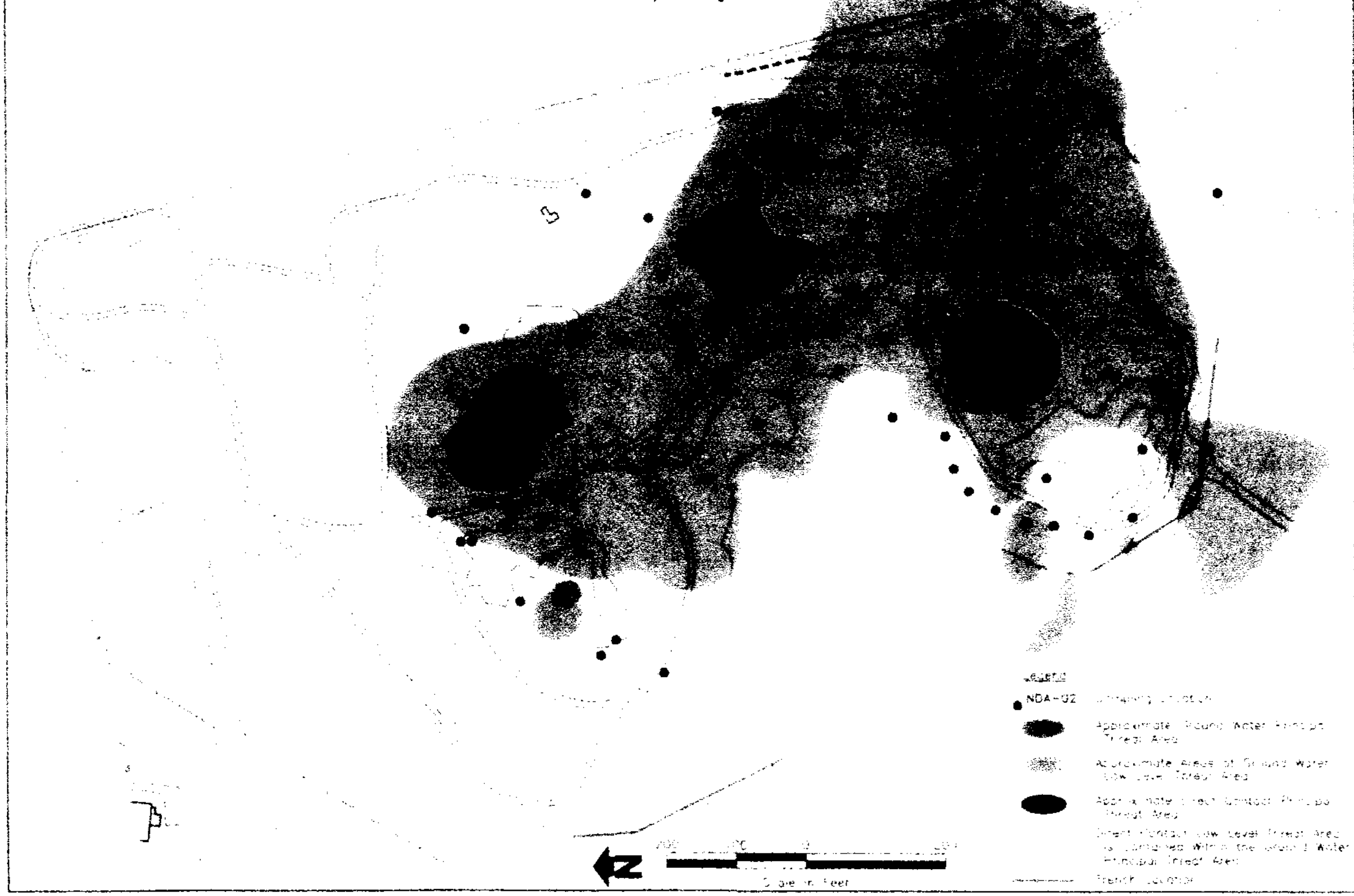


Figure 2 OU1 AND OU2 REMEDIAL MEASURES

Figure 3
Areas of Potential Concern
Maryland Sand, Gravel, and Stone
Elkton, Maryland



Tables

Table 1
Preliminary Remediation Goals

Compound of Concern	Direct Contact 10-6 (HQ=1) (mg/kg) [1]	Direct Contact 10-4 (HQ=1) (mg/kg) [2]	LDR Soil Treatment Standard (mg/kg) [3]	Principal Threat Area SSLs (mg/kg) [4]
Inorganics				
arsenic	[9]	41	[6]	[8]
lead	400 [10]	400 [10]	[6]	[8]
thallium	18	18	[6]	[8]
Volatile Organics				
1,1,1-trichloroethane	5,471	5471	60	4.57
1,1-dichloroethane	[5]	[5]	[6]	0.11
1,1-Dichloroethene	1.06	106	[6]	0.1
1,3-Dichlorobenzene	[5]	[5]	60	0.13
3,3-dichlorobenzidine	1.29	129	[6]	[7]
1,2-dichloroethane	[5]	[5]	[6]	0.11
acetone	[5]	[5]	1600	13.93
benzene	22.01	2201	100	0.11
chlorobenzene	5,002	5002	60	2.28
chloroethane	[5]	[5]	[6]	8.22
cis-1,2-dichloroethene	[5]	[5]	[6]	1.39
methylene chloride	85.11	8511	300	0.11
methyl ethyl ketone	[5]	[5]	360	43.4
methyl isobutyl ketone	[5]	[5]	330	3.2
tetrachloroethene	11.93	1193	60	0.11
toluene	52,811	52811	100	17.13
total 1,2-dichloroethene	[5]	[5]	[6]	1.26
trans-1,2-dichloroethene	[5]	[5]	[6]	2.28
trichloroethene	56.41	5641	60	0.11
vinyl chloride	0.34	34	[6]	0.09
n-butyl alcohol	[5]	[5]	26	[8]
carbon tetrachloride	[5]	[5]	60	[8]
o-cresol	[5]	[5]	56	[8]
m-cresol	[5]	[5]	56	[8]
p-cresol	[5]	[5]	56	[8]
cresol-mixed isomers	[5]	[5]	112	[8]
ethyl acetate	[5]	[5]	330	[8]
ethyl benzene	[5]	[5]	100	[8]
ethyl ether	[5]	[5]	1600	[8]
isobutyl alcohol	[5]	[5]	1700	[8]
nitrobenzene	[5]	[5]	140	[8]
pyridine	[5]	[5]	160	[8]
1,1,2-trichloroethane	[5]	[5]	60	[8]
1,1,2-trichloro-1,2,2-trifluoroethane	[5]	[5]	300	[8]
trichloromonofluoromethane	[5]	[5]	300	[8]
xylenes-mixed isomers	[5]	[5]	300	[8]
Semi-volatile Organics				
1,4-dichlorobenzene	24.01	2401	[6]	0.011
2-chlorophenol	[5]	[5]	[6]	0.69
naphthalene	[5]	[5]	[6]	0.3
bis (2-chloroethyl) ether	0.53	53	[6]	[7]
bis (2-ethylhexyl) phthalate	38.75	3875	[6]	[7]

[1] Site-specific treatment criteria for material which presents a direct contact threat and is to be placed above the water table following treatment.
[2] Site-specific treatment criteria for material which presents a direct contact threat and is to be placed below the water table following treatment.
[3] RCRA Universal Treatment Standards for soil which would be placed onsite following ex situ treatment.
[4] Site-specific soil screening levels (SSLs) applicable to ex situ treatment of Ground Water Principal Threat material. This SSL would meet the lower of the risk-based ground water criteria, an MCL, or a non-zero MCLG.
[5] Not a constituent of concern for direct contact exposure.
[6] No UTS value established for this compound.
[7] No MCL or MCLG established for this compound.
[8] Not a constituent of concern to ground water at the Site.
[9] Based on site-specific bacground concentration (95% Upper Confidence Limit on the mean). See Appendix B of the Focused Feasibility Study.
[10] EPA OSWER Directive 9200.4-27P ("Clarification to the 1994 Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities," August 1988) establishes a standard of 400 mg/kg for lead in soil on residential properties.

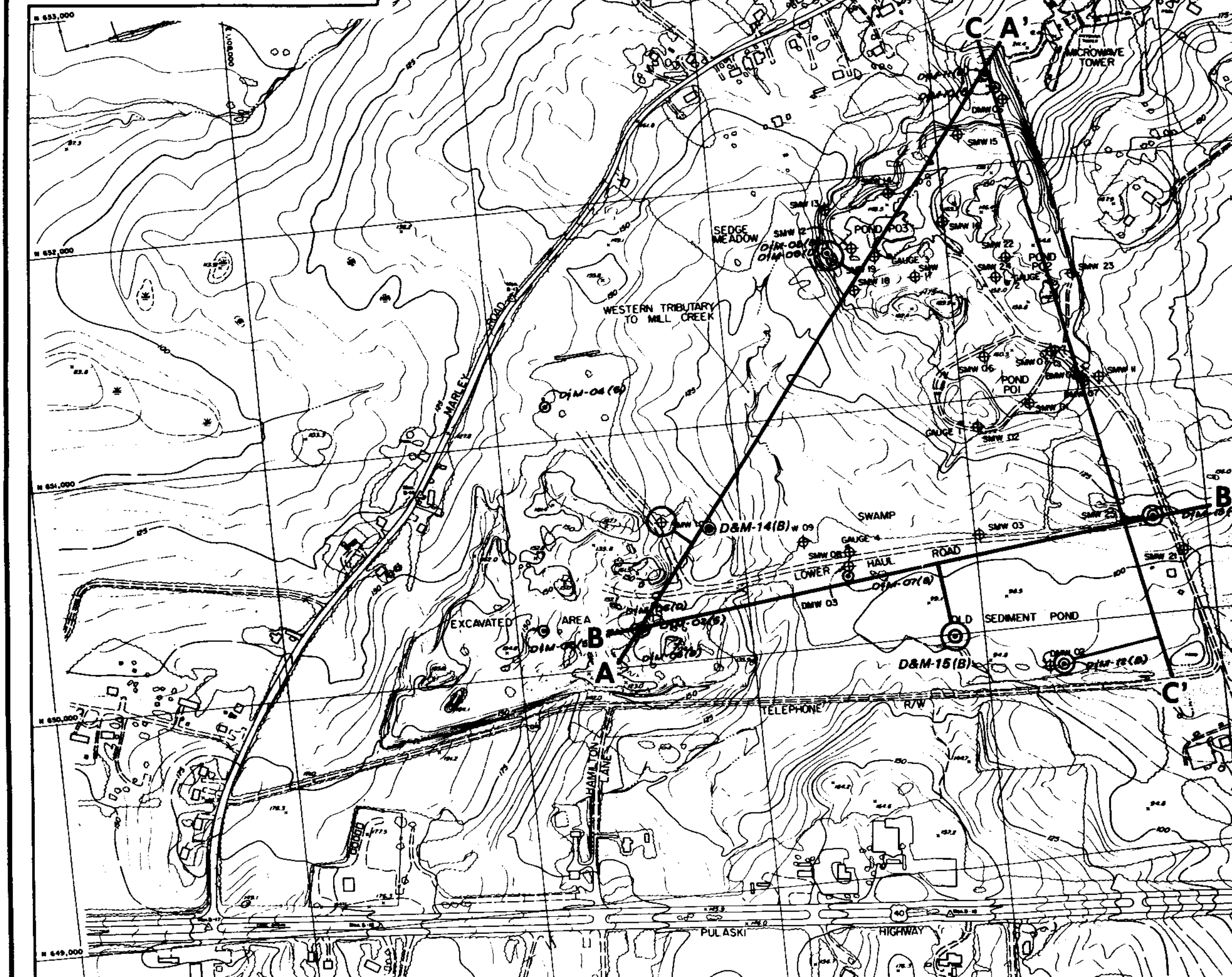
Note: Because material which meets the preliminary treatment standards for individual contaminants may not meet the cumulative risk standards specified in this Proposed Plan if multiuple contaminants are present, the final cleanup levels will be based on an assessment of the cumulative residual risk following the attainment of preliminary treatment goals. The cumulative risks associated with direct contact with the treated material, and the use of ground water which may be impacted by the treated material, would be calculated. If necessary, the soil and waste material would be further treated in order to ensure that the final remediation levels achieve the cumulative risk standards identified in Table 2-10 of the Focused Feasibility Study.

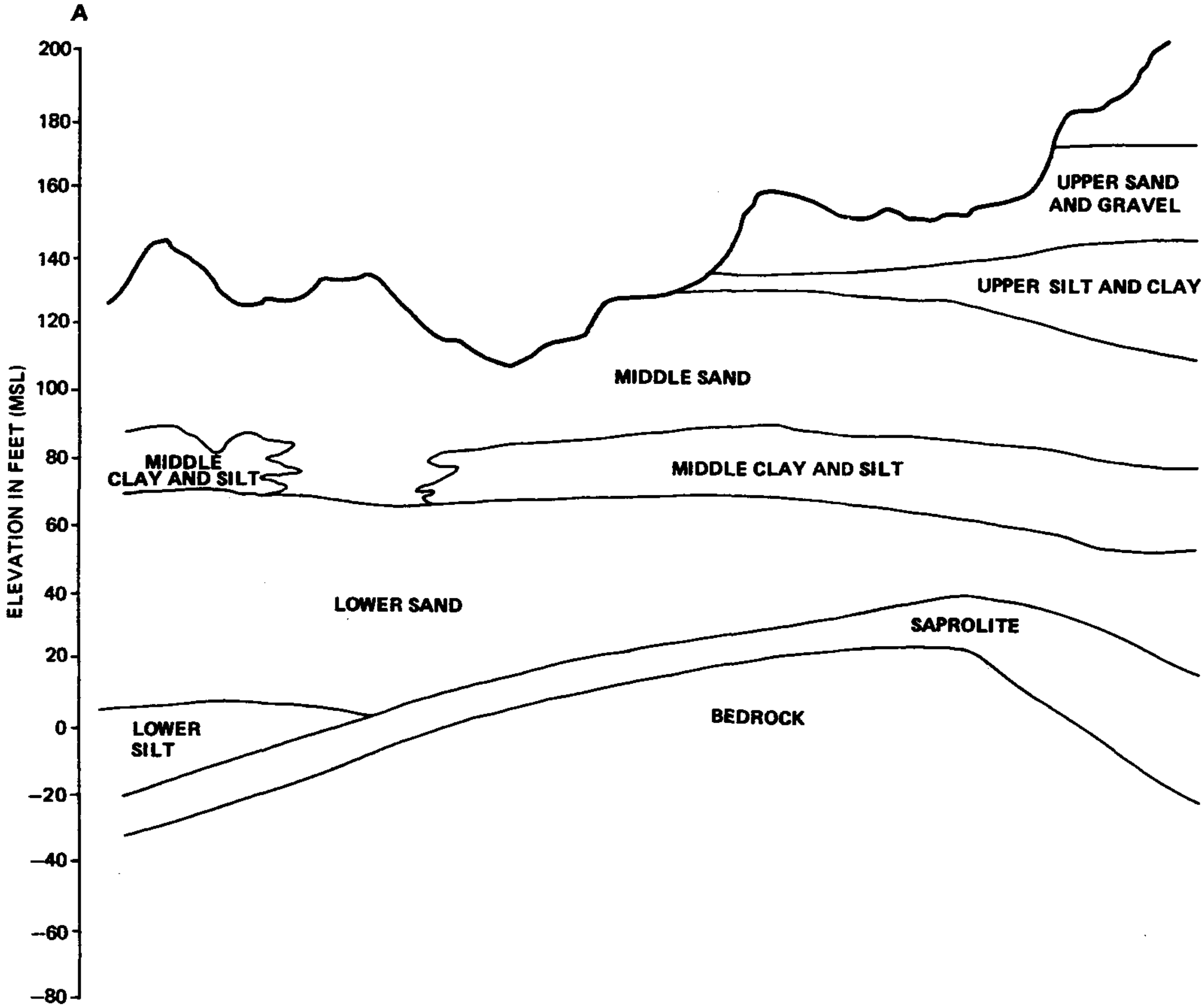
Table 2 Summary of Detailed Evaluation of Remedial Alternatives
Maryland Sand, Gravel and Stone Site, Elkton, Maryland

	REMEDIAL ALTERNATIVES							
EVALUATION CRITERIA	**Alternative 1** **No Action**	**Alternative 2** **Direct-Contact Principal Threat Removal, Cap/Barrier Wall and Operation of Ground Water Treatment System**	**Alternative 3a** **PT by LTTD, enhanced biodegredation**	**Alternative 3b** **PT by *in-situ*, enhanced biodegration**	**Alternative 3c** **unsaturated PT by LTTD, saturated PT by *in-situ* chem-ox, enhanced biodegradation**	**Alternative 4a** **PT by LTTD, low-level threat area cap and barrier wall**	**Alternative 4b** **PT by in situ, low-level threat area cap and barrier wall**	**Alternative 5** **PT and low-level threat soil (all SSL soil) by LTTD**
Overall Protection of Human Health and the Environment	Risk is not within EPA's acceptable risk range. Does not provide long-term groundwater protection.	Eliminates direct contact risks, and groundwater protection is provided by the existing ground water system.	Eliminates direct contact risk,and does provide for elimination of leaching risk for long-term groundwater protection.	Eliminates direct contact risk,and does provide for elimination of leaching risk for long-term groundwater protection.	Eliminates direct contact risk,and does provide for elimination of leaching risk for long-term groundwater protection.	Eliminates direct contact risk, provides for elimination of leaching risk for long-term groundwater protection.	Eliminates direct contact risk, provides for elimination of leaching risk for long-term groundwater protection.	Eliminates direct contact risk, provides for elimination of leaching risk for long-term groundwater protection.
Compliance with ARARs	Not Applicable	Expected to satisfy all ARARs	Expected to satisfy all ARARs.	Expected to satisfy all ARARs.	Expected to satisfy all ARARs.	Expected to satisfy all ARARs.	Expected to satisfy all ARARs.	Expected to satisfy all ARARs.
Long-Term Effectiveness and Permanence	Does not address future site use or impacted ground water migration concerns.	Restricts future site uses, prevents direct contact risks, and provides containment of low-level threat soil and ground water, with long-term improvement in ground water quality	Restricts future site uses, prevents direct contact risks, and provides for long-term control and improvement of ground water quality over time	Restricts future site uses, prevents direct contact risks, and provides for long-term control and improvement of ground water quality over time	Restricts future site uses, prevents direct contact risks, and provides for long-term control and improvement.of ground water quality over time	Restricts future site uses, prevents direct contact risks, and provides containment of low-level threat soil and ground water, with long-term improvement in ground water quality	Restricts future site uses, prevents direct contact risks, and provides containment of low-level threat soil and ground water, with long-term improvement in ground water quality	Restricts future site uses, prevents direct contact risks, and source treatment actions will result in improved ground water quality
Reduction of Toxicity, Mobility or Volume	Minimal reduction through natural attenuation.	Reduction of contaminants in ground water through extended pump treat, and direct-contact soil removal and containment of low-level threat soil.	Reduction of contaminants in ground water through source removal, extended pump and treat, and enhanced biodegradation	Reduction of contaminants in ground water through source removal, extended pump and treat, and enhanced biodegradation	Reduction of contaminants in ground water through source removal, extended pump and treat, and enhanced biodegradation	Reduction of contaminants through source area treatment, expanded ground water pump and treat, and containment of low-level threat soil	Reduction of contaminants through source area treatment, expanded ground water pump and treat, and containment of low-level threat soil	Reduction of contaminants through treatment of principal and low-level threat soil
Short-Term Effectiveness	No short-term risks or benefits.	Minor short-term risks during implementation, but immediate short-term benefits.	Greater short-term exposure risks during implementation, but immediate short-term benefit from source removal.	Greater short-term exposure risks during implementation if thermal used, but immediate short-term benefit from source removal. Minor short-term risk if chemical oxidation used.	Greater-short-term exposure risks during implementation, but immediate short-term benefit from source removal.	Greater short-term risks during implementation due to site grading and trench excavation, but immediate short-term benefits.	Greater short-term exposure risks during implementation if thermal used, but immediate short-term benefit from source removal. Minor short-term risk if chemical oxidation used.	Greater short-term risks during implementation due to extensive area excavation, with expencted short-term benefits to ground water quality.
Implementability	Can be easily and quickly implemented.	Can be easily and quickly implemented.	Can be easily and quickly implemented. PT below water table will require dewatering before treatment	Can be easily and quickly implemented. Bench-scale and pilot testing necessary for thermal or chemical oxidation technology selection	Can be easily and quickly implemented. Pilot testing of chemical oxidation necessary	Fairly easily implemented. Logistical constraints for 18-acre cap and 1300-foot long barrier wall installation	Fairly easily implemented. Logistical constraints for 18-acre cap and 1300-foot long barrier wall installation	Can be implemented, with significant logistical constraints. Will require large area sheeting, shoring, and dewatering activities.
Estimated Present Worth Cost (30-yr PW)	$2,000,000	$14,000,000	$24,000,000	$23,000,000	$21,000,000	$27,000,000	$25,000,000	$79,000,000

Appendix A
Lithologic Cross Sections

SOURCE: Base Map by Air Survey Corporation of Virginia; Reston, Virginia; Date of Photography, March 19, 1985.




A
ELEVATION IN FEET (MSL)
200
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
UPPER SAND AND GRAVEL
UPPER SILT AND CLAY
MIDDLE SAND
MIDDLE CLAY AND SILT
MIDDLE CLAY AND SILT
LOWER SAND
SAPROLITE
LOWER SILT
BEDROCK

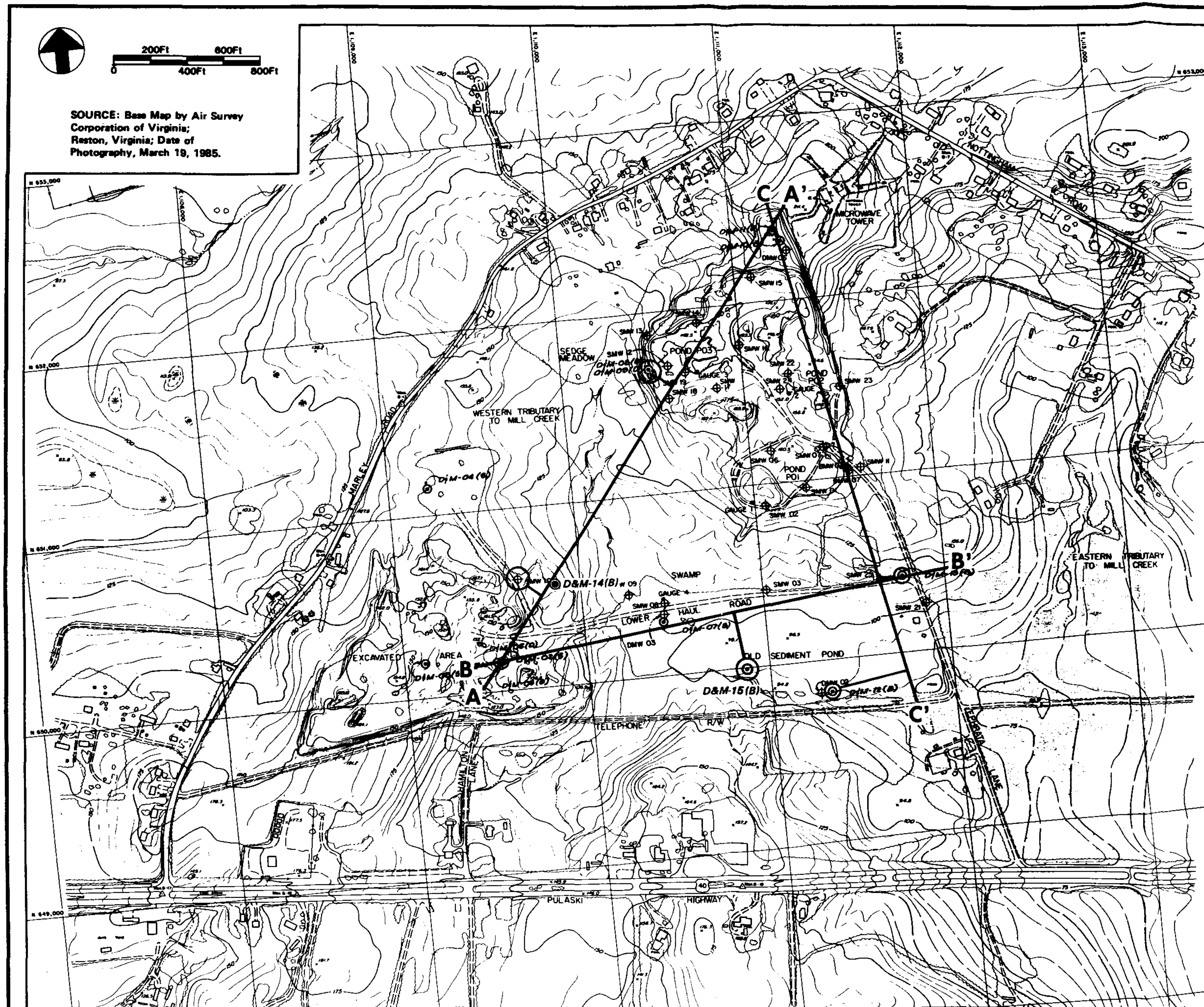
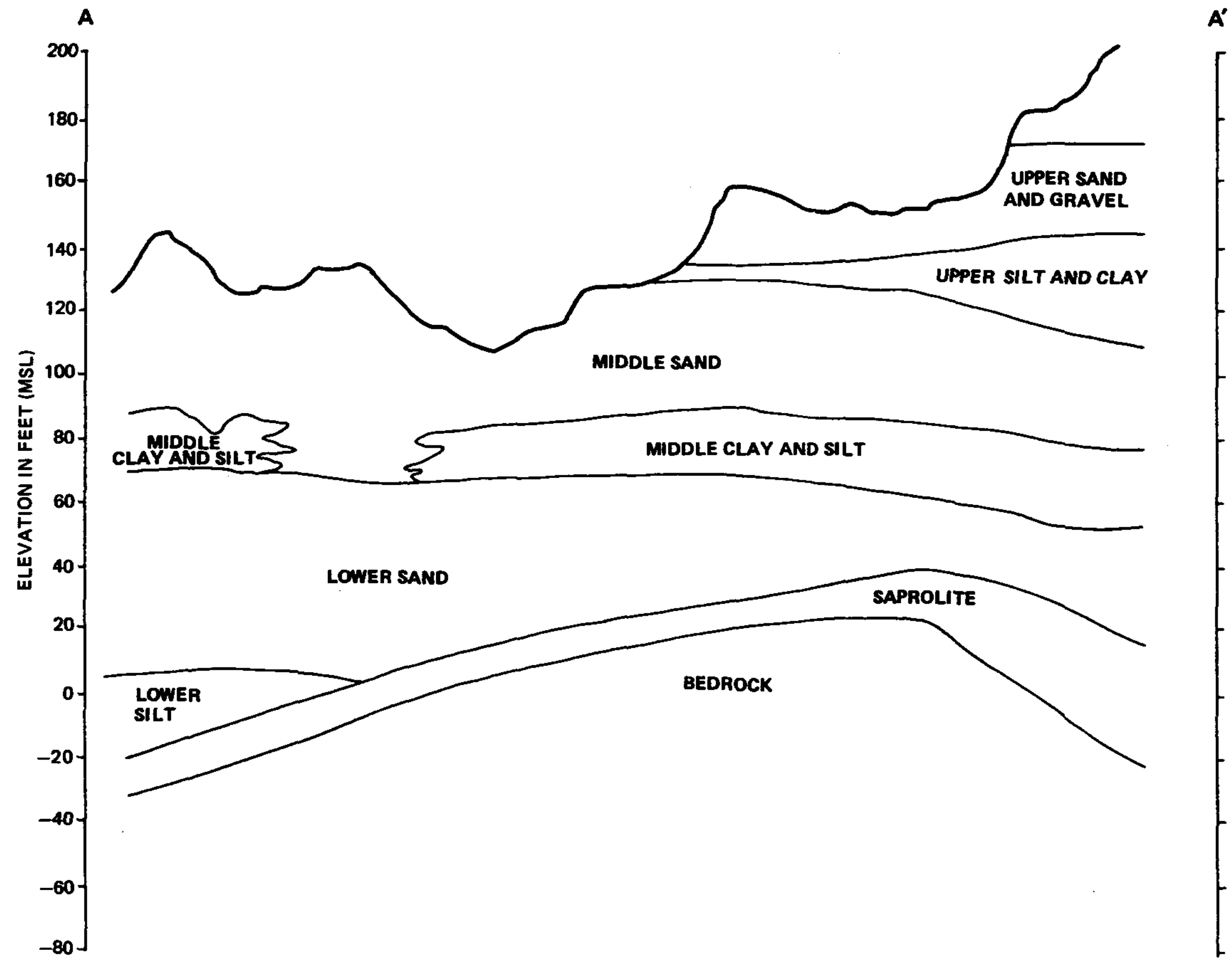


FIGURE 5-7
LOCATION OF CROSS-SECTIONS

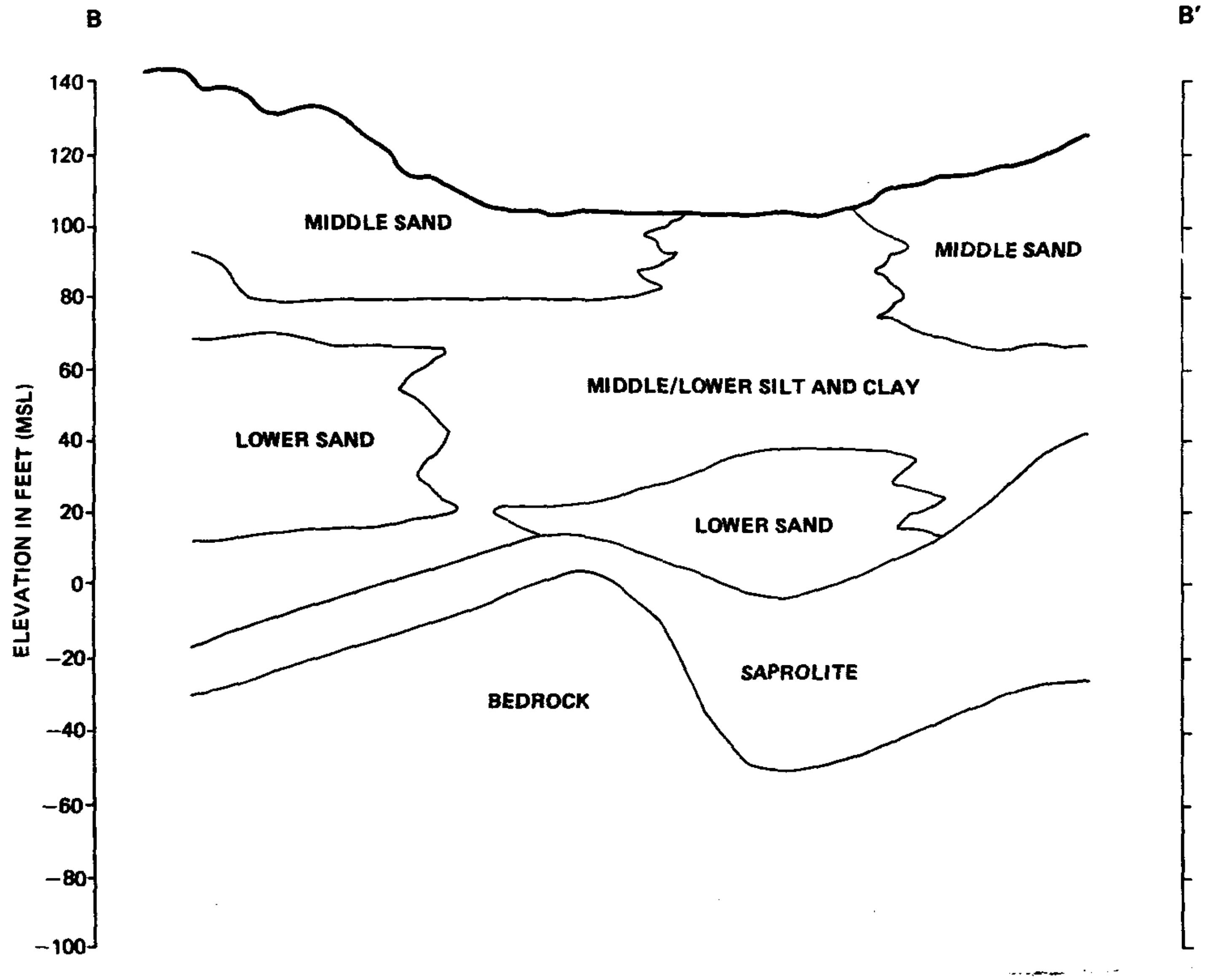
Dames & Moore



(VERTICAL EXAGGERATION 9.9X)

FIGURE 5-11
CROSS SECTION A–A' SHOWING
GROUNDWATER UNITS

Dames & Moore



(VERTICAL EXAGGERATION 13X)

FIGURE 5-12
CROSS SECTION B—B'
SHOWING GROUNDWATER UNITS

Dames & Moore

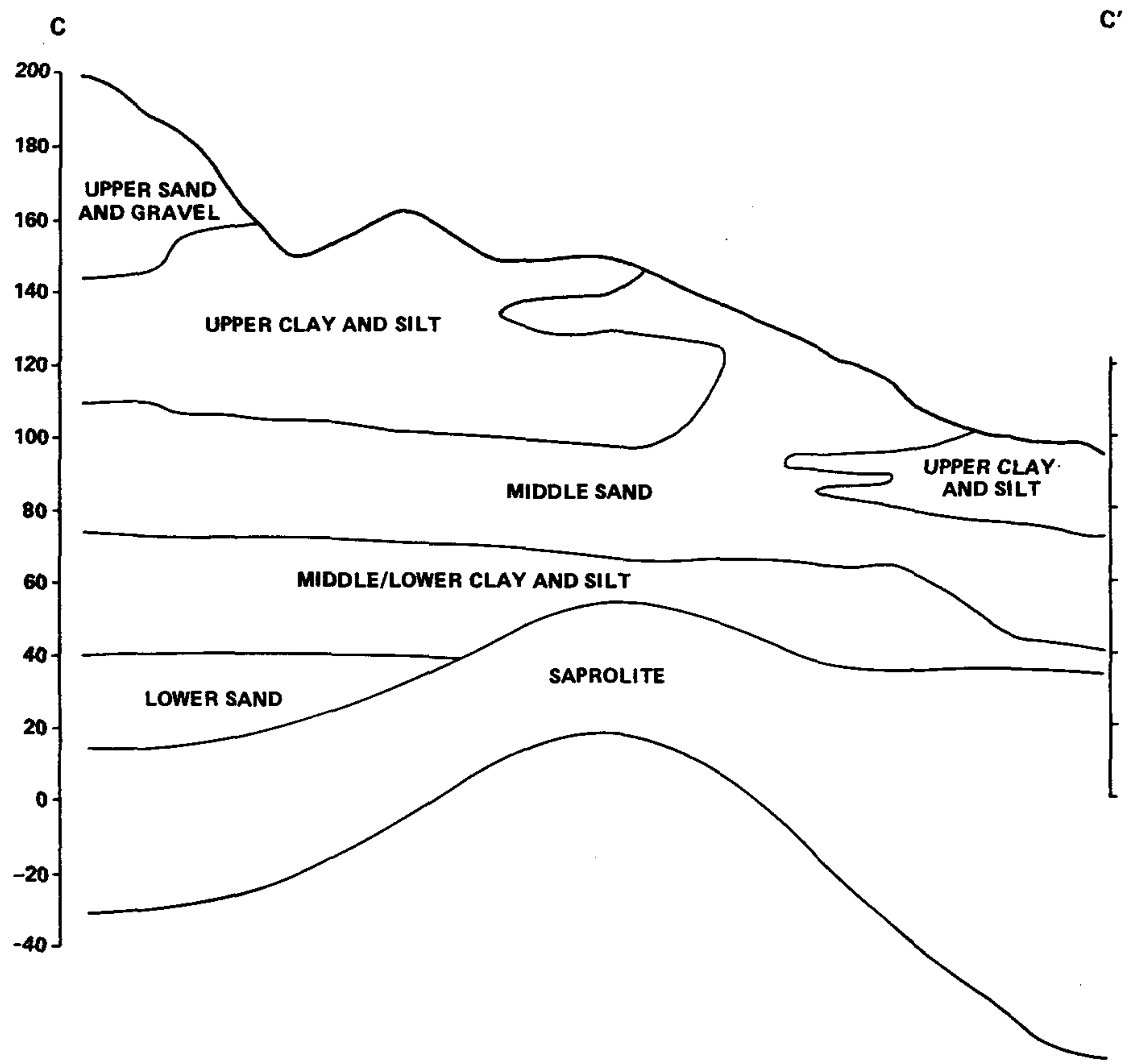
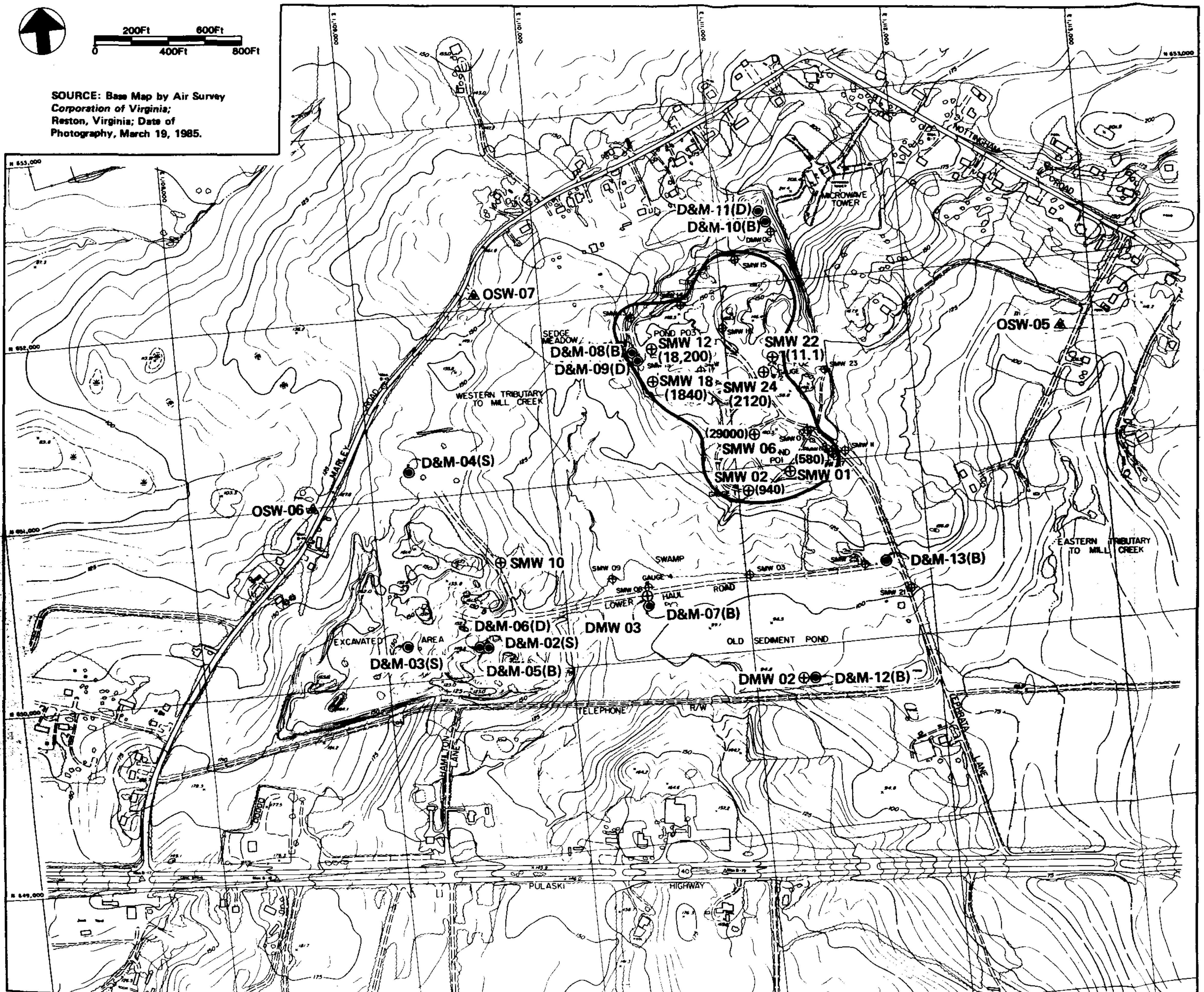


FIGURE 5-13
CROSS-SECTION C-C' SHOWING
GROUNDWATER UNITS

Dames & Moore

Appendix B
Areal Extent of Toluene Contamination in the Upper Sand and Lower Sand and Bedrock Units

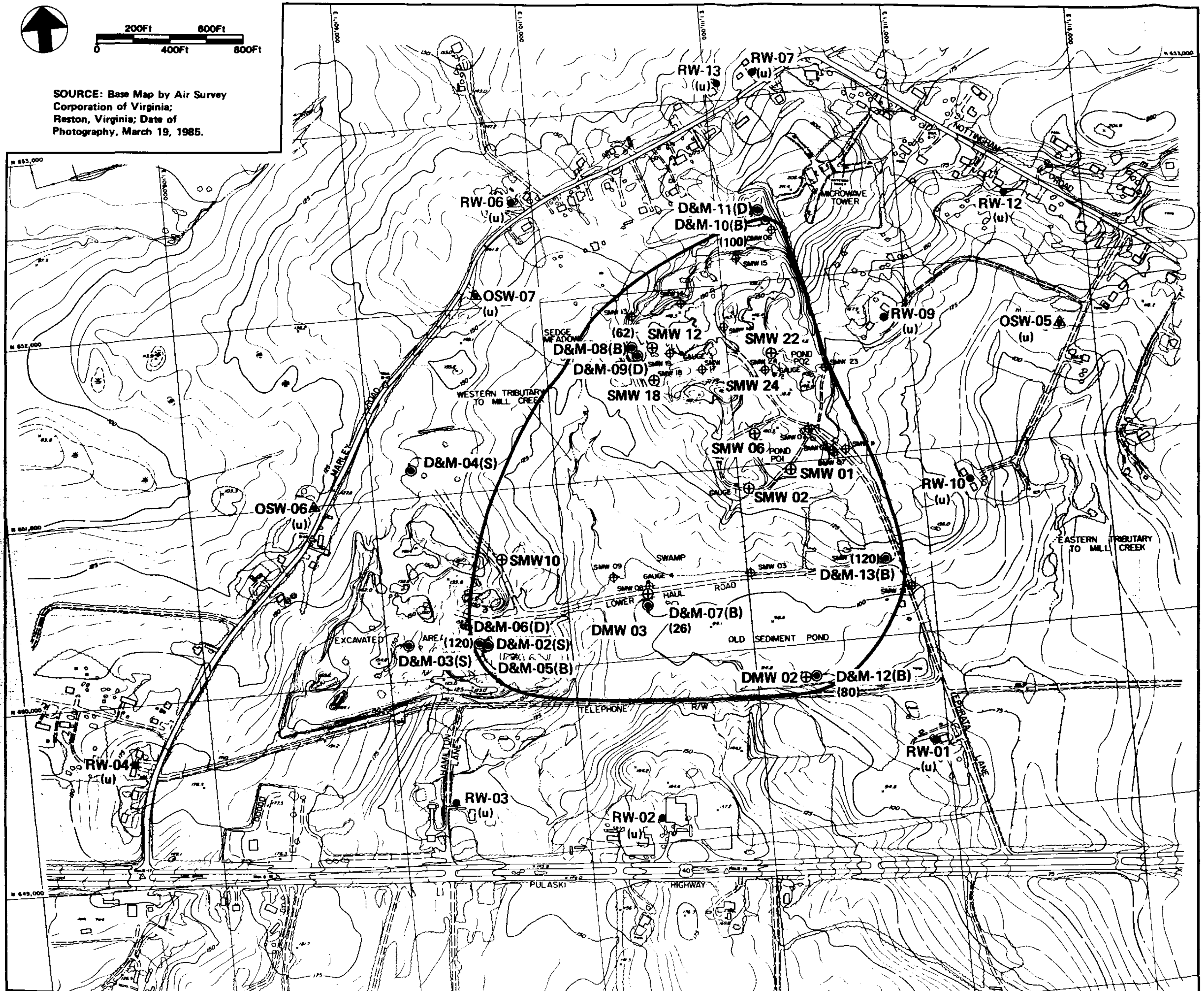


LEGEND:

- ● Well installed during Phase II
  - (S) Shallow well
  - (D) Deep well
  - (B) Bedrock well
- ⊕ Well installed during Phase I
  - SMW Shallow well
  - DMW Deep well
  - BMW Bedrock well
- ▲ Off-site well (OSW)
- (u) Toluene not detected
- (10) Maximum Toluene concentration (ug/l)

FIGURE 5-25
AREAL EXTENT OF TOLUENE DETECTED IN UPPER SAND AND GRAVEL AQUIFER

Dames & Moore



LEGEND:

- ● Well installed during Phase II
  - (S) Shallow well
  - (D) Deep well
  - (B) Bedrock well
- ⊕ Well installed during Phase I
  - SMW Shallow well
  - DMW Deep well
  - BMW Bedrock well
- ▲ Off-site well Sampled during Phase II (OSW)
- • Off-site well Sampled during Phase I (RW)
- (u) Toluene not detected
- (10) Maximum Toluene concentration (ug/l)

FIGURE 5-26
AREAL EXTENT OF TOLUENE DETECTED IN LOWER SAND AND BEDROCK AQUIFERS

Dames & Moore

Appendix C
Ranges of Contaminant Concentrations in Soils, by Source Area

Table 5-12
Summary of Detected Organic Compounds
Pond 01

Compound Detected	Concentration Range (µg/Kg)	Number of Samples	Number of Detections
Volatile Organic Compounds			
VINYL CHLORIDE	24 - 160	14	2
CHLOROETHANE	26 - 78	14	2
1,1-DICHLOROETHENE	180	14	1
1,1-DICHLOROETHANE	9 - 230	14	4
METHYLENE CHLORIDE	280	14	1
1,2-DICHLOROETHANE	1 - 300	14	3
CIS-1,2-DICHLOROETHENE	32 - 2,500	14	2
TRANS-1,2-DICHLOROETHENE	2	14	1
2-BUTANONE	10 - 3,600	14	3
1,1,1-TRICHLOROETHANE	2 - 2,000	14	3
4-METHYL-2-PENTANONE	6 - 110	14	3
TRICHLOROETHENE	1 - 33	14	3
BENZENE	4 - 190	14	4
2-HEXANONE	16	14	1
TOLUENE	26 - 8,800	14	3
CHLOROBENZENE	9 - 4,800	14	3
ETHYLBENZENE	25 - 140	14	2
M,P-XYLENE	2 - 47	14	3
O-XYLENE	1 - 300	14	3
Semivolatile Organic Compounds			
PHENOL	200	13	1
1,3-DICHLOROBENZENE	34	13	1
4-METHYLPHENOL	41	13	1
ISOPHORONE	16	13	1
1,2,4-TRICHLOROBENZENE	13	13	1
DIETHYLPHTHALATE	19	13	1
BUTYLBENZYLPHTHALATE	18 - 51	13	3
BIS(2-ETHYLHEXYL)PHTHALATE	1,600 - 1,700	13	2
Pesticides/PCBs	ND	3	0
[illegible]	130		1

ND: Not Detected

Table 5-13
Summary of Detected Inorganics
Pond 01

Element Detected	Maximum Background Concentration (mg/Kg)	Concentration Range (mg/Kg)	Number of Samples	Number of Detections Above Background
BARIUM	1,500	23 - 200	13	0
CALCIUM	280,000	720 - 1,200	13	0
CHROMIUM	630	130 - 520	13	0
COBALT	70	31	13	0
COPPER	26	4.6 - 12.2	13	0
IRON	100,000	1,900 - 23,000	13	0
LEAD	19	16 - 65	13	2
MANGANESE	7,000	30 - 66	13	0
NICKEL	79	62 - 130	13	1
POTASSIUM	37,000	2600 - 11,000	13	0
VANADIUM	300	99 - 220	13	0
ZINC	22	11 - 25	13	1

Table 5-14
Summary of Detected Organic Compounds
Pond 02

Compound Detected	Concentration Range (µg/Kg)	Number of Samples	Number of Detections
Volatile Organic Compounds			
CHLOROMETHANE	1 - 150	38	3
VINYL CHLORIDE	41 - 970	38	4
CHLOROETHANE	12 - 140	38	5
ACETONE	1,500 - 270,000	38	2
CARBON DISULFIDE	1 - 15	38	2
1,1-DICHLOROETHENE	1,800 - 12,000	38	3
1,1-DICHLOROETHANE	4 - 2,100	38	7
METHYLENE CHLORIDE	1,200 - 550,000	38	3
1,2-DICHLOROETHANE	4 - 5,200	38	4
CIS-1,2-DICHLOROETHENE	7 - 1,200	38	7
TRANS-1,2-DICHLOROETHENE	17	38	1
2-BUTANONE	2 - 18	38	12
1,1,1-TRICHLOROETHANE	6 - 2,900,000	38	14
CARBON TETRACHLORIDE	6	38	1
4-METHYL-2-PENTANONE	32 - 520,000	38	16
TRICHLOROETHENE	3 - 3,000,000	38	15
DIBROMOCHLOROMETHANE	5,000,000	38	1
BENZENE	1 - 130,000	38	18
TRANS-1,3-DICHLOROPROPENE	110	38	1
2-HEXANONE	3 - 250,000	38	3
TETRACHLOROETHENE	6 - 7,900,000	38	14
1,1,2,2-TETRACHLOROETHANE	51 - 69	38	2
TOLUENE	20 - 24,000,000	38	15
CHLOROBENZENE	27 - 11,000,000	38	16
ETHYLBENZENE	2 - 1,100,000	38	15
STYRENE	1	38	1
M,P-XYLENE	1 - 4,100,000	38	18
O-XYLENE	3 - 1,700,000	38	19
Semivolatile Organic Compounds			
PHENOL	460 - 49,000	36	4
BIS(2-CHLOROETHYL)ETHER	6,400	36	1
1,4-DICHLOROBENZENE	120 - 700,000	36	8
1,2-DICHLOROBENZENE	31 - 100,000	36	8
2-METHYLPHENOL	10 - 11,000	36	10
4-METHYLPHENOL	20 - 100,000	36	13
ISOPHORONE	21 - 100,000	36	8

Table 5-14 (continued)
Summary of Detected Organic Compounds
Pond 02

Compound Detected	Concentration Range (µg/Kg)	Number of Samples	Number of Detections
Semivolatile Organic Compounds (cont)			
2,4-DIMETHYLPHENOL	1,300 - 29,000	36	3
1,2,4-TRICHLOROBENZENE	24 - 16,000	36	8
NAPHTHALENE	13 - 300,000	36	11
HEXACHLOROBUTADIENE	1,700	36	1
2-METHYLNAPHTHALENE	13 - 100,000	36	10
DIMETHYLPHTHALATE	1,100	36	1
ACENAPHTHENE	49 - 470	36	2
DIETHYLPHTHALATE	11 - 6,700	36	4
DIBENZOFURAN	80 - 4,600	36	3
FLUORENE	120 - 8,300	36	6
4,6-DINITRO-2-METHYLPHENOL	66	36	1
HEXACHLOROBENZENE	760	36	1
N-NITROSODIPHENYLAMINE	700	36	1
PENTACHLOROPHENOL	630	36	1
PHENANTHRENE	32 - 10,000	36	8
DI-N-BUTYLPHTHALATE	1,100 - 300,000	36	6
FLUORANTHENE	14	36	1
PYRENE	240 - 430	36	2
BUTYLBENZYLPHTHALATE	22 - 300,000	36	13
BIS(2-ETHYLHEXYL)PHTHALATE	1,300 - 200,000	36	7
DI-N-OCTYLPHTHALATE	47 - 31,000	36	5

Table 5-15
Summary of Detected Inorganics
Pond 02

Element Detected	Maximum Background Concentration (mg/Kg)	Detected Range (mg/Kg)	Number of Samples	Number of Detections Above Background
ANTIMONY	96	8.4 - 160	36	1
ARSENIC	34	15 - 32	36	0
BARIUM	1,500	12 - 2,600	36	1
CALCIUM	280,000	720 - 5,600	36	0
CHROMIUM	630	60 - 3,700	36	3
COPPER	26	20 - 710	36	3
IRON	100,000	2,800 - 49,000	36	0
LEAD	19	11 - 34,000	36	5
MANGANESE	7,000	34 - 150	36	0
MERCURY	15.5	280	36	1
NICKEL	79	68 - 250	36	3
POTASSIUM	37,000	1,500 - 13,000	36	0
SELENIUM	ND	130	36	1
THALLIUM	6.9	25 - 900	36	3
VANADIUM	300	38 - 2,000	36	1
ZINC	22	12 - 700	36	6

ND: Not Detected

Table 5-16
Summary of Detected Pesticides/PCBs
Pond 02

Compound Detected	Concentration Range (µg/Kg)	Number of Samples	Number of Detections
ALDRIN	3,900 - 39,000	8	2
P,P'-METHOXYCHLOR	2,400	8	1
AROCLOR-1242	3,000 - 40,000	8	2

Table 5-17
Summary of Detected Organic Compounds
Pond 03

Compound Detected	Concentration Range (µg/Kg)	Number of Samples	Number of Detections
Volatile Organic Compounds			
CHLOROMETHANE	3	21	1
VINYL CHLORIDE	33 - 45	21	2
CHLOROETHANE	4 - 35	21	3
CARBON DISULFIDE	3	21	1
1,1-DICHLOROETHENE	35 - 40	21	2
1,1-DICHLOROETHANE	45 - 90	21	3
CHLOROFORM	59	21	1
1,2-DICHLOROETHANE	1 - 2	21	2
CIS-1,2-DICHLOROETHENE	23 - 170	21	7
TRANS-1,2-DICHLOROETHENE	51	21	1
2-BUTANONE	2 - 13,000	21	6
1,1,1-TRICHLOROETHANE	2 - 1,800	21	13
CARBON TETRACHLORIDE	7	21	1
4-METHYL-2-PENTANONE	3 - 13,000	21	11
1,2-DICHLOROPROPANE	1	21	1
TRICHLOROETHENE	9 - 1,800	21	10
1,1,2-TRICHLOROETHANE	1 - 19	21	7
BENZENE	1 - 170	21	11
2-HEXANONE	3 - 16	21	3
TETRACHLOROETHENE	2 - 650,000	21	7
1,1,2,2-TETRACHLOROETHANE	13	21	1
TOLUENE	130 - 1,000	21	8
CHLOROBENZENE	3 - 580,000	21	11
ETHYLBENZENE	3 - 180,000	21	14
M,P-XYLENE	2 - 620,000	21	12
O-XYLENE	2 - 620,000	21	16
Semivolatile Organic Compounds			
1,4-DICHLOROBENZENE	200,000	21	1
1,2-DICHLOROBENZENE	26,000	21	1
2-METHYLPHENOL	35 - 57	21	2
4-METHYLPHENOL	32 - 45	21	2
1,2,4-TRICHLOROBENZENE	14,000	21	1
NAPHTHALENE	8,600	21	1
2-METHYLNAPHTHALENE	1,900	21	1
N-NITROSODIPHENYLAMINE	2,100	21	1
BUTYLBENZYLPHTHALATE	24,000	21	1

Table 5-17 (continued)
Summary of Detected Organic Compounds
Pond 03

Pesticides/PCBs	ND	5	0

ND: Not Detected

Table 5-18
Summary of Detected Inorganics
Pond 03

Element Detected	Maximum Background Concentration (mg/Kg)	Detected Range (mg/Kg)	Number of Samples	Number of Detections Above Background
ANTIMONY	96	8.7	21	0
BARIUM	1,500	11 - 150	21	0
CADMIUM	37	10 - 40	21	1
CALCIUM	280,000	760 - 1,200	21	0
CHROMIUM	630	75 - 320	21	0
COBALT	70	53	21	0
COPPER	26	22	21	0
IRON	100,000	2,800 - 19,000	21	0
LEAD	19	10 - 1,100	21	1
MANGANESE	7,000	31 - 110	21	0
NICKEL	79	97	21	1
POTASSIUM	37,000	1,600 - 11,000	21	0
THALLIUM	6.9	51	21	1
VANADIUM	300	76 - 260	21	0
ZINC	22	11 - 52	21	7

Table 5-19
Summary of Detected Organic Compounds
Northern Depression Area

Compound Detected	Concentration Range (μg/Kg)	Number of Samples	Number of Detections
Volatile Organic Compounds			
ACETONE	4,000,000 - 4,400,000	9	2
METHYLENE CHLORIDE	1,000,000	9	1
1,1,1-TRICHLOROETHANE	23 - 65,000,000	9	5
4-METHYL-2-PENTANONE	4,400,000	9	1
TRICHLOROETHENE	5 - 14,000,000	9	4
BENZENE	1 - 2,300,000	9	3
TETRACHLOROETHENE	51,000,000 - 110,000,000	9	2
TOLUENE	3 - 230,000,000	9	4
CHLOROBENZENE	45,000 - 270,000,000	9	3
ETHYLBENZENE	4,900,000 - 9,300,000	9	2
M,P-XYLENE	7,900 - 39,000,000	9	3
O-XYLENE	8,300,000 - 16,000,000	9	2
Semivolatile Organic Compounds			
BIS(2-CHLOROETHYL)ETHER	68,000	8	1
1,3-DICHLOROBENZENE	1,000,000	8	1
1,4-DICHLOROBENZENE	600,000 - 1,000,000	8	2
1,2-DICHLOROBENZENE	72,000 - 200,000	8	2
2-METHYLPHENOL	13,000	8	1
4-METHYLPHENOL	25,000	8	1
HEXACHLOROETHANE	5,500	8	1
NITROBENZENE	4,000	8	1
ISOPHORONE	5,000	8	1
2,4-DIMETHYLPHENOL	1,000	8	1
1,2,4-TRICHLOROBENZENE	24,000 - 54,000	8	2
NAPHTHALENE	15,000 - 30,000	8	2
4-CHLORO-3-METHYLPHENOL	5,800	8	1
2-METHYLNAPHTHALENE	12,000 - 26,000	8	2
2-NITROANILINE	24,000	8	1
DIMETHYLPHTHALATE	1,100	8	1
2,6-DINITROTOLUENE	3,000	8	1
2,4-DINITROTOLUENE	2,900	8	1
DIBENZOFURAN	1,600	8	1
FLUORENE	1,300 - 2,700	8	2
4,6-DINITRO-2-METHYLPHENOL	750	8	1
N-NITROSODIPHENYLAMINE	6,400	8	1
PHENANTHRENE	2,300 - 4,500	8	2

Table 5-19 (continued)
Summary of Detected Organic Compounds
Northern Depression Area

Compound Detected	Concentration Range (µg/Kg)	Number of Samples	Number of Detections
Semivolatile Organic Compounds (cont)			
ANTHRACENE	2,300	8	1
BUTYLBENZYLPHTHALATE	85,000 - 100,000	8	2
3,3'-DICHLOROBENZIDINE	2,400	8	1
BIS(2-ETHYLHEXYL)PHTHALATE	19	8	1

Table 5-20
Summary of Detected Inorganics
Northern Depression Area

Element Detected	Maximum Background Concentration (mg/Kg)	Detected Range (mg/Kg)	Number of Samples	Number of Detections Above Background
ANTIMONY	96	9.7 - 36	8	0
BARIUM	1,500	18 - 320	8	0
CADMIUM	37	7.9 - 160	8	1
CALCIUM	280,000	750 - 1,300	8	0
CHROMIUM	630	60 - 560	8	0
COPPER	26	84 - 150	8	2
IRON	100,000	4,100 - 43,000	8	0
LEAD	19	14 - 3,100	8	2
MANGANESE	7,000	31 - 340	8	0
MERCURY	15.5	28	8	1
NICKEL	79	150 - 320	8	3
POTASSIUM	37,000	2,700 - 10,000	8	0
THALLIUM	6.9	52 - 160	8	2
VANADIUM	300	85 - 290	8	0
ZINC	22	13 - 300	8	3

Table 5-21
Summary of Detected Organic Compounds
Buried Waste Area

Compound Detected	Concentration Range (μg/Kg)	Number of Samples	Number of Detections
Volatile Organic Compounds			
ACETONE	910	13	1
1,1-DICHLOROETHENE	65 - 64,000	13	4
METHYLENE CHLORIDE	220	13	1
CHLOROFORM	26 - 5,200	13	3
1,2-DICHLOROETHANE	170	13	1
CIS-1,2-DICHLOROETHENE	11	13	1
2-BUTANONE	5,100 - 32,000	13	3
1,1,1-TRICHLOROETHANE	110 - 4,000,000	13	6
4-METHYL-2-PENTANONE	4,900 - 450,000	13	4
TRICHLOROETHENE	430 - 1,100,000	13	7
BENZENE	56 - 51,000	13	6
2-HEXANONE	32 - 8,200	13	2
TETRACHLOROETHENE	410 - 2,900,000	13	10
TOLUENE	1,100 - 3,600,000	13	9
CHLOROBENZENE	1,300 - 3,300,000	13	7
ETHYLBENZENE	76 - 230,000	13	8
STYRENE	1,900 - 30,000	13	3
M,P-XYLENE	190 - 1,200,000	13	10
O-XYLENE	180 - 520,000	13	8
Semivolatile Organic Compounds			
PHENOL	420 - 620	12	2
1,3-DICHLOROBENZENE	2,000 - 19,000	12	6
1,4-DICHLOROBENZENE	16 - 65,000	12	7
1,2-DICHLOROBENZENE	18 - 42,000	12	8
2-METHYLPHENOL	21 - 160	12	3
4-METHYLPHENOL	35 - 410	12	5
ISOPHORONE	420 - 41,000	12	6
2,4-DIMETHYLPHENOL	490	12	1
1,2,4-TRICHLOROBENZENE	39 - 300,000	12	9
NAPHTHALENE	3,000 - 8,800	12	6
4-CHLOROANILINE	360	12	1
2-METHYLNAPHTHALENE	290 - 2,900	12	6
DIMETHYLPHTHALATE	31	12	1
2,6-DINITROTOLUENE	150	12	1
ACENAPHTHENE	77 - 100	12	3
DIETHYLPHTHALATE	18 - 49	12	2

Table 5-21 (continued)
Summary of Detected Organic Compounds
Buried Waste Area

Compound Detected	Concentration Range (µg/Kg)	Number of Samples	Number of Detections
Semivolatile Organic Compounds (cont)			
FLUORENE	53 - 190	12	4
PHENANTHRENE	16 - 300	12	6
DI-N-BUTYLPHTHALATE	9,300	12	1
FLUORANTHENE	11 - 64	12	3
PYRENE	16 - 27	12	2
BUTYLBENZYLPHTHALATE	6,600 - 41,000	12	5
3,3'-DICHLOROBENZIDINE	12 - 20	12	2
BENZO(A)ANTHRACENE	15	12	1
CHRYSENE	14	12	1
BIS(2-ETHYLHEXYL)PHTHALATE	4,200 - 14,000	12	4
DI-N-OCTYLPHTHALATE	270 - 1,800	12	5
Pesticides/PCBs			
AROCLOR 1016	160	4	1

ND: Not Detected

Table 5-22
Summary of Detected Inorganics
Buried Waste Area

Element Detected	Maximum Background Concentration (mg/Kg)	Detected Range (mg/Kg)	Number of Samples	Number of Detections Above Background
ARSENIC	34	15	12	0
BARIUM	1,500	21 - 360	12	0
CADMIUM	37	9.4	12	0
CALCIUM	280,000	760 - 1,400	12	0
CHROMIUM	630	72 - 160	12	0
COPPER	26	20 - 57	12	1
IRON	100,000	4,600 - 17,000	12	0
LEAD	19	15 - 61	12	4
MANGANESE	7,000	37 - 98	12	0
NICKEL	79	97	12	1
POTASSIUM	37,000	3,800 - 12,000	12	0
VANADIUM	300	98 - 240	12	0
ZINC	22	12 - 32	12	2

Table 5-23
Summary of Detected Organic Compounds
Area South of Pond 01

Compound Detected	Concentration Range (µg/Kg)	Number of Samples	Number of Detections
Semivolatile Organic Compounds			
NAPHTHALENE	46	6	1
2-METHYLNAPHTHALENE	73	6	1
Pesticides/PCBs	ND	1	0

ND: Not Detected

Table 5-24
Summary of Detected Inorganics
Area South of Pond 01

Element Detected	Maximum Background Concentration (mg/Kg)	Detected Range (mg/Kg)	Number of Samples	Number of Detections Above Background
ARSENIC	34	15 - 22	6	0
BARIUM	1,500	64 - 350	6	0
CALCIUM	280,000	1,000 - 2,300	6	0
CHROMIUM	630	560	6	0
COBALT	70	35	6	0
COPPER	26	20 - 22	6	0
IRON	100,000	7,700 - 25,000	6	0
LEAD	19	10 - 19	6	0
MANGANESE	7,000	50 - 92	6	0
POTASSIUM	37,000	6,000 - 12,000	6	0
VANADIUM	300	150 - 210	6	0
ZINC	22	18 - 28	6	2

Table 5-25
Summary of Detected Organic Compounds
Soil Staging Area

Compounds Detected	Concentration Range (μg/Kg)	Number of Samples	Number of Detections
Volatile Organic Compounds			
CHLOROMETHANE	2	11	1
VINYL CHLORIDE	16 - 32	11	2
CHLOROETHANE	5 - 220	11	5
1,1-DICHLOROETHANE	13 - 72	11	3
1,2-DICHLOROETHANE	2 - 22	11	3
CIS-1,2-DICHLOROETHENE	40 - 1,200	11	2
TRANS-1,2-DICHLOROETHENE	17	11	1
2-BUTANONE	250	11	1
1,1,1-TRICHLOROETHANE	5 - 42	11	4
4-METHYL-2-PENTANONE	100 - 830	11	2
TRICHLOROETHENE	3 - 320	11	4
BENZENE	4 - 260	11	8
TETRACHLOROETHENE	6 - 22	11	3
TOLUENE	10 - 190	11	7
CHLOROBENZENE	20 - 7,600	11	7
ETHYLBENZENE	3 - 180	11	6
M,P-XYLENE	2 - 130	11	7
O-XYLENE	4 - 71	11	7
Semivolatile Organic Compounds			
1,4-DICHLOROBENZENE	33 - 34	11	2
2-METHYLPHENOL	20	11	1
4-METHYLPHENOL	24	11	1
1,2,4-TRICHLOROBENZENE	50	11	1
2-METHYLNAPHTHALENE	21	11	1
DIETHYLPHTHALATE	13 - 120	11	3
BUTYLBENZYLPHTHALATE	12 - 68	11	3
Pesticides/PCBs	ND	3	0

ND: Not Detected

Table 5-26
Summary of Detected Inorganics
Soil Staging Area

Elements Detected	Maximum Background Concentration (mg/Kg)	Detected Range (mg/Kg)	Number of Samples	Number of Detections
BARIUM	1,500	22 - 270	11	0
CALCIUM	280,000	750 - 1,900	11	0
CHROMIUM	630	71 - 190	11	0
IRON	100,000	2,500 - 25,000	11	0
LEAD	19	11	11	0
MANGANESE	7,000	34 - 96	11	0
NICKEL	79	160	11	1
POTASSIUM	37,000	3,000 - 15,000	11	0
SILVER	0.78	4.1	11	1
VANADIUM	300	70 - 230	11	0
ZINC	22	11 - 39	11	1

Table 5-27
Summary of Detected Organic Compounds
Soil Stockpile Area

Compound Detected	Concentration Range (µg/Kg)	Number of Samples	Number of Detections
Volatile Organic Compounds			
VINYL CHLORIDE	430	9	1
CHLOROETHANE	130	9	1
1,1-DICHLOROETHENE	14	9	1
1,1-DICHLOROETHANE	240	9	1
METHYLENE CHLORIDE	55	9	1
CHLOROFORM	36	9	1
CIS-1,2-DICHLOROETHENE	26 - 8,900	9	2
2-BUTANONE	40 - 20,000	9	2
1,1,1-TRICHLOROETHANE	470	9	1
4-METHYL-2-PENTANONE	20 - 4,500	9	4
TRICHLOROETHENE	4 - 1,000	9	4
BENZENE	11 - 45	9	3
BROMOFORM	860	9	1
2-HEXANONE	3,300	9	1
TETRACHLOROETHENE	9 - 1,400	9	5
TOLUENE	20 - 6,500	9	5
CHLOROBENZENE	15 - 14,000	9	8
ETHYLBENZENE	21 - 820	9	6
STYRENE	340	9	1
M,P-XYLENE	27 - 1,500	9	6
O-XYLENE	36 - 1,300	9	5
Semivolatile Organic Compounds			
2-CHLOROPHENOL	17	9	1
1,3-DICHLOROBENZENE	15	9	1
1,4-DICHLOROBENZENE	29 - 120	9	7
1,2-DICHLOROBENZENE	18 - 110	9	7
2-METHYLPHENOL	14	9	1
4-METHYLPHENOL	17 - 150	9	2
ISOPHORONE	18 - 61	9	3
1,2,4-TRICHLOROBENZENE	12 - 250	9	8
2-METHYLNAPHTHALENE	13 - 33	9	7
ACENAPHTHENE	38	9	1
DIETHYLPHTHALATE	60	9	1
DIBENZOFURAN	18	9	1
FLUORENE	25	9	1
PHENANTHRENE	24	9	1

Table 5-27 (continued)
Summary of Detected Organic Compounds
Soil Stockpile Area

Compound Detected	Concentration Range (µg/Kg)	Number of Samples	Number of Detections
Semivolatile Organic Compounds (cont)			
BUTYLBENZYLPHTHALATE	16 - 170	9	3
BIS(2-ETHYLHEXYL)PHTHALATE	730 - 1,000	9	2
Pesticides/PCBs	ND	9	0

ND: Not Detected

Table 5-28
Summary of Detected Inorganics
Soil Stockpile Area

Element Detected	Maximum Background Concentration (mg/Kg)	Detected Range (mg/Kg)	Number of Samples	Number of Detections Above Background
BARIUM	1,500	150 - 220	9	0
CALCIUM	280,000	1,000 - 1,400	9	0
CHROMIUM	630	57 - 150	9	0
COPPER	26	22	9	0
IRON	100,000	12,000 - 15,000	9	0
LEAD	19	14 - 140	9	3
MANGANESE	7,000	57 - 110	9	0
POTASSIUM	37,000	7,300 - 10,000	9	0
VANADIUM	300	180 - 220	9	0
ZINC	22	11 - 23	9	1

Table 5-29
Summary of Detected Organic Compounds
Seep 01

Compound Detected	Concentration Range (µg/Kg)	Number of Samples	Number of Detections
Volatile Organic Compounds			
CHLOROETHANE	1 - 580	14	4
ACETONE	220 - 1,300	14	2
1,1-DICHLOROETHANE	350	14	1
METHYLENE CHLORIDE	1 - 8	14	3
TRANS-1,2-DICHLOROETHENE	10	14	1
2-BUTANONE	5 - 480	14	9
4-METHYL-2-PENTANONE	71	14	1
BENZENE	1 - 4,600	14	8
2-HEXANONE	120	14	1
TOLUENE	50 - 110	14	2
CHLOROBENZENE	24 - 13,000	14	8
ETHYLBENZENE	2 - 9,100	14	6
M,P-XYLENE	1 - 3,400	14	5
O-XYLENE	1 - 12,000	14	5
Semivolatile Organic Compounds			
2-CHLOROPHENOL	1,700	14	1
1,3-DICHLOROBENZENE	13 - 4,100	14	4
1,4-DICHLOROBENZENE	17 - 16,000	14	6
1,2-DICHLOROBENZENE	20 - 4,200	14	3
2-METHYLPHENOL	3,400	14	1
4-METHYLPHENOL	460	14	1
2,4-DIMETHYLPHENOL	450	14	1
1,2,4-TRICHLOROBENZENE	2,500	14	1
2-METHYLNAPHTHALENE	530	14	1
FLUORANTHENE	67	14	1
PYRENE	61	14	1
BENZO(K)FLUORANTHENE	13 - 94	14	2
BENZO(A)PYRENE	15	14	1
Pesticides/PCBs	ND	2	0

ND: Not Detected

Table 5-30
Summary of Detected Inorganics
Seep 01

Element Detected	Maximum Background Concentration (mg/Kg)	Detected Range (mg/Kg)	Number of Samples	Number of Detections Above Background
ARSENIC	34	11 - 570	14	1
BARIUM	1,500	20 - 250	14	0
CALCIUM	280,000	880 - 2,600	14	0
CHROMIUM	630	55 - 190	14	0
COPPER	26	42 - 55	14	2
IRON	100,000	2,500 - 730,000	14	2
LEAD	19	10 - 180	14	5
MANGANESE	7,000	64 - 320	14	0
NICKEL	79	360 - 650	14	2
POTASSIUM	37,000	1,700 - 14,000	14	0
SELENIUM	ND	11	14	1
THALLIUM	6.9	37	14	1
VANADIUM	300	18 - 250	14	0
ZINC	22	11 - 96	14	2

ND: Not Detected

Table 5-31
Summary of Detected Organic Compounds
Seep 02

Compound Detected	Concentration Range (µg/Kg)	Number of Samples	Number of Detections
Volatile Organic Compounds			
CHLOROETHANE	7 - 8	12	2
1,1-DICHLOROETHANE	2 - 20	12	5
CIS-1,2-DICHLOROETHENE	1 - 8	12	5
TRANS-1,2-DICHLOROETHENE	2	12	1
1,1,1-TRICHLOROETHANE	3	12	1
TRICHLOROETHENE	1 - 18	12	4
BENZENE	2 - 11	12	3
TETRACHLOROETHENE	3 - 150	12	4
TOLUENE	370	12	1
CHLOROBENZENE	2 - 1,200	12	9
ETHYLBENZENE	2 - 60	12	4
STYRENE	2	12	1
M,P-XYLENE	2 - 110	12	4
O-XYLENE	1 - 90	12	4
Semivolatile Organic Compounds			
2-CHLOROPHENOL	28	12	1
1,4-DICHLOROBENZENE	47	12	1
1,2-DICHLOROBENZENE	15	12	1
2-METHYLPHENOL	17	12	1
4-METHYLPHENOL	19	12	1
NAPHTHALENE	30 - 190	12	2
2-METHYLNAPHTHALENE	36	12	1
DIETHYLPHTHALATE	100	12	1
CHRYSENE	69	12	1
BIS(2-ETHYLHEXYL)PHTHALATE	13 - 83	12	12
Pesticides/PCBs	ND	12	0

ND: Not Detected

Table 5-32
Summary of Detected Inorganics
Seep 02

Element Detected	Maximum Background Concentration (mg/Kg)	Concentration Range (mg/Kg)	Number of Samples	Number of Detections Above Background
BARIUM	1,500	58 - 260	12	0
CALCIUM	280,000	780 - 1,800	12	0
CHROMIUM	630	170	12	0
IRON	100,000	9,500 - 58,000	12	0
LEAD	19	11 - 26	12	1
MANGANESE	7,000	34 - 94	12	0
POTASSIUM	37,000	7,400 - 14,000	12	0
VANADIUM	300	110 - 210	12	0
ZINC	22	13 - 39	12	4

Table 5-33
Summary of Detected Organic Compounds
Seep 03

Compound Detected	Concentration Range (µg/Kg)	Number of Samples	Number of Detections
Volatile Organic Compounds			
VINYL CHLORIDE	8 - 65	20	3
CHLOROETHANE	7 - 290	20	6
ACETONE	300	20	1
1,1-DICHLOROETHENE	3 - 22	20	3
1,1-DICHLOROETHANE	3 - 190	20	4
CHLOROFORM	3 - 4	20	2
1,2-DICHLOROETHANE	29	20	1
CIS-1,2-DICHLOROETHENE	4 - 5	20	2
2-BUTANONE	6 - 100	20	4
1,1,1-TRICHLOROETHANE	2 - 260	20	3
4-METHYL-2-PENTANONE	5	20	1
TRICHLOROETHENE	1 - 14	20	4
BENZENE	2 - 50	20	7
2-HEXANONE	3	20	1
TETRACHLOROETHENE	50 - 65	20	2
1,1,2,2-TETRACHLOROETHANE	1	20	1
TOLUENE	6 - 19	20	2
CHLOROBENZENE	2 - 6,000	20	14
ETHYLBENZENE	10 - 94	20	6
M,P-XYLENE	12 - 330	20	5
O-XYLENE	1 - 140	20	6
Semivolatile Organic Compounds			
1,4-DICHLOROBENZENE	120 - 500	20	5
1,2-DICHLOROBENZENE	52 - 71	20	2
1,2,4-TRICHLOROBENZENE	17	20	1
NAPHTHALENE	14 - 100	20	5
2-METHYLNAPHTHALENE	13 - 25	20	4
PHENANTHRENE	20	20	1
FLUORANTHENE	22	20	1
BUTYLBENZYLPHTHALATE	18 - 26	20	2
BIS(2-ETHYLHEXYL)PHTHALATE	25	20	1
BENZO(K)FLUORANTHENE	24	20	1
Pesticides/PCBs	ND	4	0

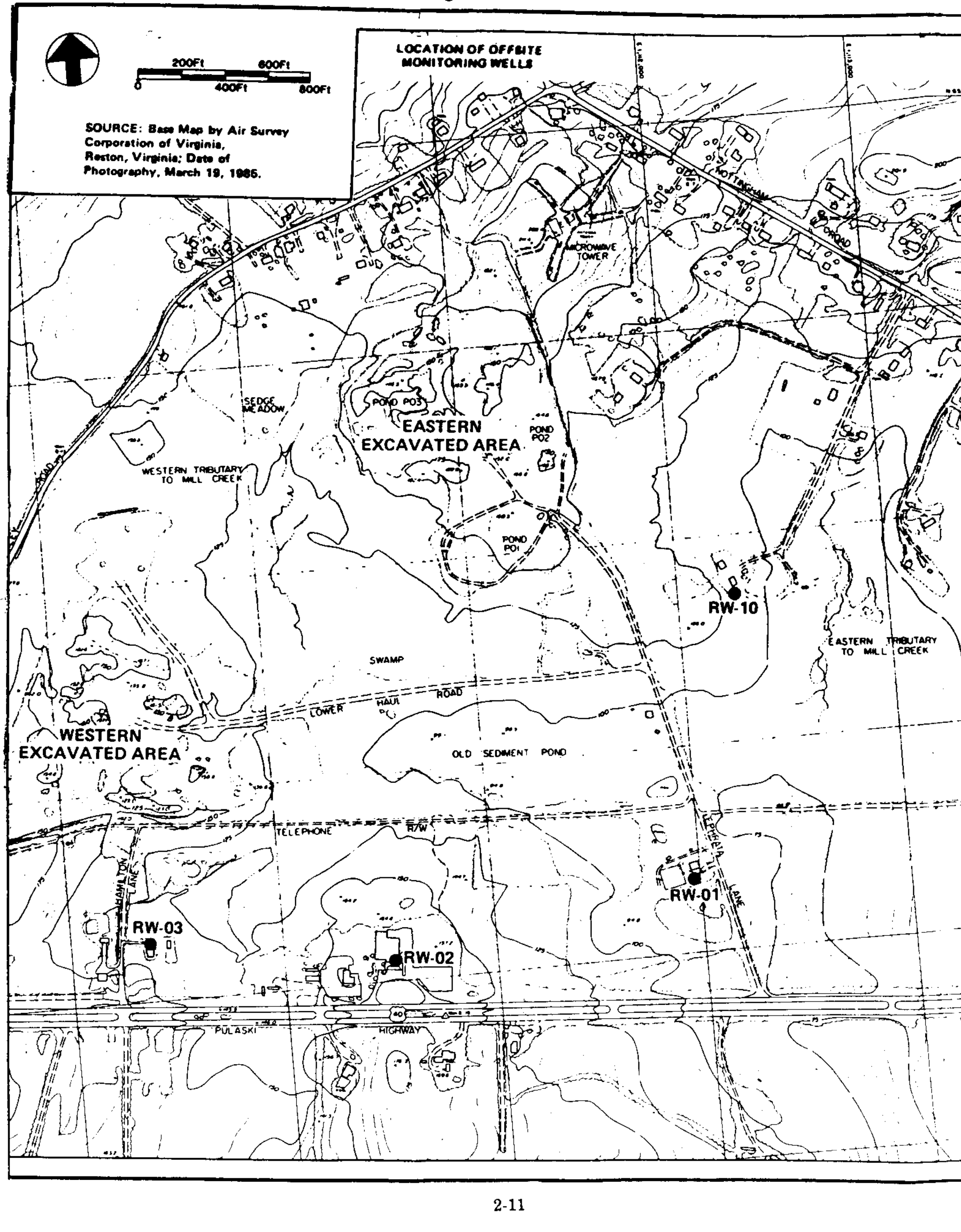
ND: Not Detected

Table 5-34
Summary of Detected Inorganics
Seep 03

Element Detected	Maximum Background Concentration (mg/Kg)	Detected Range (mg/Kg)	Number of Samples	Number of Detections Above Background
ANTIMONY	96	6	20	0
BARIUM	1,500	29 - 400	20	0
CALCIUM	280,000	730 - 2,000	20	0
CHROMIUM	630	56 - 130	20	0
COBALT	70	26 - 37	20	0
COPPER	26	20 - 35	20	1
IRON	100,000	4,100 - 24,000	20	0
LEAD	19	12 - 33	20	7
MANGANESE	7,000	39 - 140	20	0
POTASSIUM	37,000	2,600 - 13,000	20	0
VANADIUM	300	120 - 230	20	0
ZINC	22	11 - 61	20	7

Appendix D
Residential Well Locations and Annual Monitoring Data

Figure 2-4



200Ft
600Ft
0
400Ft
800Ft
SOURCE: Base Map by Air Survey Corporation of Virginia, Reston, Virginia; Date of Photography, March 19, 1985.
LOCATION OF OFFSITE MONITORING WELLS
MICROWAVE TOWER
SEDGE MEADOW
POND PO3
EASTERN EXCAVATED AREA
POND PO2
WESTERN TRIBUTARY TO MILL CREEK
POND PO1
RW-10
EASTERN TRIBUTARY TO MILL CREEK
SWAMP
LOWER HAUL ROAD
WESTERN EXCAVATED AREA
OLD SEDIMENT POND
TELEPHONE
R/W
HAMILTON LANE
EPHRATA LANE
RW-01
RW-03
RW-02
PULASKI HIGHWAY

TABLE 11

MARYLAND SAND, GRAVEL AND STONE SITE
PHASE II GROUNDWATER MONITORING PROGRAM
THIRTY-THIRD QUARTERLY SAMPLING RESULTS

VOLATILE ORGANIC ANALYSIS - RESIDENTIAL GROUNDWATER SAMPLES (Annual)

WELL LOCATION	RW-1	RW-3
EPA SAMPLE NO.	RW-1	RW-3
DATE SAMPLED	11/13/2000	11/13/2000
CONCENTRATION UNIT	ug/l	ug/l
1,1,1-Trichloroethane	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U
1,1-Dichloroethane	1 U	1 U
1,1-Dichloroethene	1 U	1 U
1,2-Dichloroethane	1 U	1 U
1,2-Dichloroethene (Total)	1 U	1 U
1,2-Dichloropropane	1 U	1 U
2-Butanone	5 U	5 U
2-Hexanone	5 U	5 U
4-Methyl-2-pentanone	1 U	1 U
Acetone	7.3 B	5.1 B
Benzene	1 U	1 U
Bromodichloromethane	1 U	1 U
Bromoform	1 U	1 U
Bromomethane	1 U	1 U
Carbon Disulfide	1 U	1 U
Carbon tetrachloride	1 U	1 U
Chlorobenzene	1 U	1 U
Chlorodibromomethane	NA	NA
Chloroethane	1 U	1 U
Chloroform	1 U	0.44 J
Chloromethane	0.14 J	0.14 J
cis-1,2-Dichloroethene	NA	NA
cis-1,3-Dichloropropene	1 U	1 U
Dibromochloromethane	1 U	1 U
Ethylbenzene	1 U	1 U
Methylene chloride	0.72 J	0.68 J
Styrene	1 U	1 U
Tetrachloroethene	1 U	1 U
Toluene	1 U	1 U
trans-1,2-Dichloroethene	NA	NA
trans-1,3-Dichloropropene	1 U	1 U
Trichloroethene	1 U	1 U
Vinyl chloride	1 U	1 U
Xylene (total)	1 U	1 U

NOTES:
(1) "U" = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
(2) "B" = Not detected. Not detected substantially above the level reported in laboratory or field blanks.

TABLE 12

MARYLAND SAND, GRAVEL AND STONE SITE
PHASE II GROUNDWATER MONITORING PROGRAM
THIRTY-THIRD QUARTERLY SAMPLING RESULTS

DISSOLVED METALS ANALYSIS - RESIDENTIAL GROUNDWATER SAMPLES (Annual)

WELL LOCATION	RW-1	RW-3
EPA SAMPLE NO.	RW-1	RW-3
DATE SAMPLED	11/13/2000	11/13/2000
CONCENTRATION UNIT	ug/l	ug/l
Aluminum	70.8 B	93.2 B
Antimony	60.0 U	60.0 U
Arsenic	10.0 U	10.0 U
Barium	33.3	25.2
Beryllium	0.79 B	0.41 B
Cadmium	0.40 B	0.61 B
Calcium	1780	2740
Chromium	10.0 U	10.0 U
Cobalt	3.8 B	2.0 B
Copper	1.6 B	48.8
Iron	4100 J	209 B
Lead	3.0 UL	5.2 L
Magnesium	796	1700
Manganese	62.9	9.2
Mercury	0.20 U	0.20 U
Nickel	5.0 B	40.0 U
Potassium	662 B	828 B
Selenium	5.0 UL	5.0 UL
Silver	10.0 U	10.0 U
Sodium	3280	6280
Thallium	10.0 UL	10.0 UL
Vanadium	50.0 U	50.0 U
Zinc	13.1 B	18.3 B

NOTES:
(1) "U" = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
(2) "UJ" = Not detected. Quantitation limit may be inaccurate or imprecise.
(3) "UL" = Not detected. Quantitation limit is probably higher.
(4) "B" = Not detected. Not detected substantially above the level reported in laboratory or field blanks.
(5) "J" = Analyte present. Reported value may not be accurate or precise.
(6) "L" = Reported value may be biased low. Actual value is expected to be higher.

TABLE 11

MARYLAND SAND, GRAVEL AND STONE SITE
PHASE II GROUNDWATER MONITORING PROGRAM
THIRTY-SEVENTH QUARTERLY SAMPLING RESULTS

VOLATILE ORGANIC ANALYSIS - RESIDENTIAL GROUNDWATER SAMPLES (Annual)

WELL LOCATION	RW-1	RW-3
EPA SAMPLE NO.	RW-1	RW-3
DATE SAMPLED	12/18/01	12/18/01
CONCENTRATION UNIT	ug/l	ug/l
1,1,1-Trichloroethane	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U
1,1-Dichloroethane	1 U	1 U
1,1-Dichloroethene	1 U	1 U
1,2-Dichloroethane	1 U	1 U
1,2-Dichloropropane	1 U	1 U
2-Butanone	5 R	5 R
2-Hexanone	5 U	5 U
4-Methyl-2-pentanone	1 U	1 U
Acetone	5 R	5 R
Benzene	1 U	1 U
Bromodichloromethane	1 U	1 U
Bromoform	1 U	1 U
Bromomethane	1 U	1 U
Carbon Disulfide	0.21 J	1 U
Carbon tetrachloride	1 U	1 U
Chlorobenzene	1 U	1 U
Chloroethane	1 U	1 U
Chloroform	1 U	0.36 J
Chloromethane	1 U	1 U
cis-1,2-Dichloroethene	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U
Dibromochloromethane	1 U	1 U
Ethylbenzene	1 U	1 U
Methylene chloride	2 U	2 U
Styrene	1 U	1 U
Tetrachloroethene	1 U	1 U
Toluene	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U
Trichloroethene	1 U	1 U
Vinyl chloride	1 U	1 U
Xylene (total)	1 U	1 U

NOTES:
(1) "U" = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
(2) "J" = Analyte present. Reported value may not be accurate or precise.
(3) "R" = Unusable Result. Analyte may or may not be present in the sample.

TABLE 12

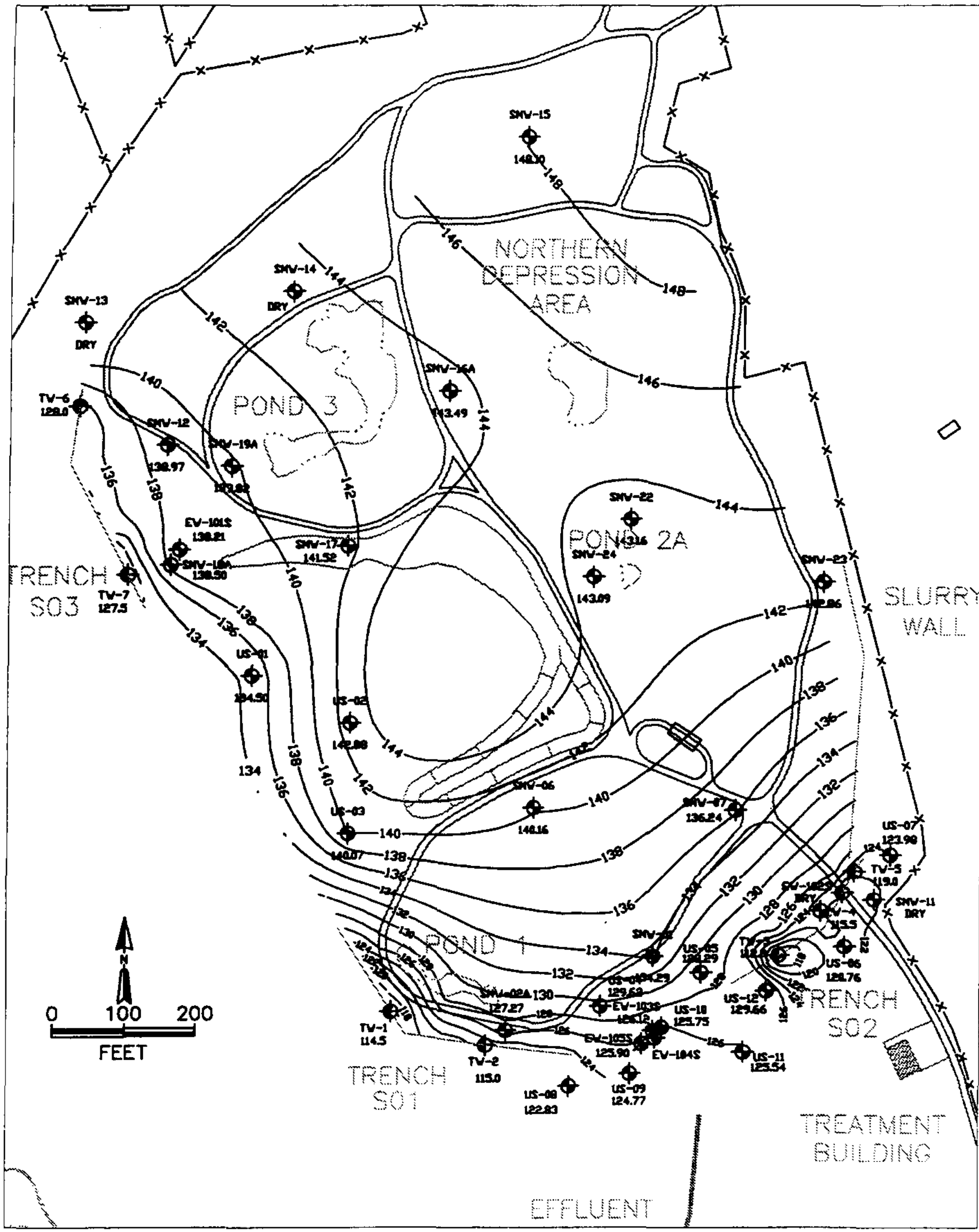
MARYLAND SAND, GRAVEL AND STONE SITE
PHASE II GROUNDWATER MONITORING PROGRAM
THIRTY-SEVENTH QUARTERLY SAMPLING RESULTS

DISSOLVED METALS ANALYSIS - RESIDENTIAL GROUNDWATER SAMPLES (Annual)

WELL LOCATION	RW-1	RW-3
EPA SAMPLE NO.	RW-1	RW-3
DATE SAMPLED	11/13/01	11/13/01
CONCENTRATION UNIT	ug/l	ug/l
Aluminum	24.4 B	25.5 B
Antimony	2.7 U	2.7 U
Arsenic	1.7 UL	1.7 UL
Barium	33.5 J	27.1 J
Beryllium	0.72 B	0.14 U
Cadmium	0.2 B	0.21 B
Calcium	1740 J	2820 J
Chromium	0.45 U	0.45 U
Cobalt	1.3 B	2 B
Copper	0.82 U	59.3
Iron	15700	42.5 B
Lead	1.3 UL	8.8 B
Magnesium	814 J	1840 J
Manganese	173	7 J
Mercury	0.1 U	0.1 U
Nickel	2.5 B	3.8 B
Potassium	470 B	691 J
Selenium	2.9 UL	2.9 UL
Silver	0.85 U	0.85 U
Sodium	2590 J	6210
Thallium	7.3 U	7.3 U
Vanadium	0.36 U	0.36 U
Zinc	2.2 U	7.5 B

NOTES:
(1) "U" = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
(2) "UJ" = Not detected. Quantitation limit may be inaccurate or imprecise.
(3) "UL" = Not detected. Quantitation limit is probably higher.
(4) "B" = Not detected. Not detected substantially above the level reported in laboratory or field blanks.
(5) "J" = Analyte present. Reported value may not be accurate or precise.
(6) "L" = Reported value may be biased low. Actual value is expected to be higher.

Appendix E
Upper Sand Ground Water Monitoring Locations, Potentiometric Surface Map, and Ground Water Quality Data



Baker	TITLE: Groundwater Contours Upper Sand – Nov. 2001 MSG&S, Elkton, MD	DWN: dsf	DES.: dsf
		CHKD: jcb	APPD:
		DATE: 12/03/01	REV.: 0

PROJECT NO.: 24004

FIGURE NO.: 1

TABLE 6

MARYLAND SAND, GRAVEL, AND STONE SITE
PHASE I GROUNDWATER MONITORING PROGRAM
TWENTY-THIRD QUARTERLY SAMPLING RESULTS

VOLATILE ORGANIC ANALYSIS - UPPER SAND GROUNDWATER SAMPLES (Quarterly)

WELL LOCATION	SMW-01	US-1	US-2	US-3	US-4	US-5	US-9	US-10	US-11
EPA SAMPLE NO.	SMW-01	US-1	US-2	US-3	US-4	US-5	US-9	US-10	US-11
DATE SAMPLED	11/07/01	11/07/01	11/07/01	11/07/01	11/07/01	11/07/01	11/07/01	11/07/01	11/07/01
CONCENTRATION UNIT	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
1,1,1-Trichloroethane	1100	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
1,1,2,2-Tetrachloroethane	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	240 J
1,1,2-Trichloroethane	~ 200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
1,1-Dichloroethane	210	3.1 J	10 U	3.1 J	71 U	830 U	17 J	1000 U	1800
1,1-Dichloroethene	65 J	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
1,2-Dichloroethane	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
1,2-Dichloroethene (TOTAL)	2200	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	2400
1,2-Dichloropropane	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
2-Butanone	200 U	10 U	10 U	10 U	71 U	830 U	20 J	790 J	1200 U
2-Hexanone	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	230 J
4-Methyl-2-pentanone	230	10 U	10 U	10 U	71 U	830 U	120 U	2200	900 J
Acetone	97 B	2.6 B	10 U	10 U	19 B	200 B	26 B	1600 B	810 B
Benzene	52 J	10 U	10 U	10 U	130	1000	89 J	520 J	450 J
Bromodichloromethane	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
Bromoform	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
Bromomethane	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
Carbon Disulfide	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
Carbon tetrachloride	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
Chlorobenzene	2300	10 U	1.1 J	10 U	1100	16000	2100	15000	17000
Chloroethane	200 U	10 U	10 U	10 U	19 J	1300	150	1300	1400
Chloroform	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
Chloromethane	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
cis-1,3-Dichloropropene	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
Dibromochloromethane	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
Ethylbenzene	76 J	10 U	10 U	10 U	63 J	640 J	42 J	550 J	680 J
Methylene chloride	410	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	200 J
Styrene	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
Tetrachloroethene	220	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
Toluene	1100	10 U	10 U	10 U	71 U	9200	27 J	8900	9300
trans-1,2-Dichloropropene	200 U	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
Trichloroethene	350	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	1200 U
Vinyl chloride	220	10 U	10 U	10 U	71 U	830 U	120 U	1000 U	2700
Xylene (total)	460	10 U	10 U	10 U	120	3100	14 J	2900	3700

NOTES:
(1) "U" = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
(2) "B" = Not detected. Not detected substantially above the level reported in laboratory or field blanks.
(4) "J" = Analyte present. Reported value may not be accurate or precise.

TABLE 7

MARYLAND SAND, GRAVEL, AND STONE SITE
PHASE I GROUNDWATER MONITORING PROGRAM
TWENTY-THIRD QUARTERLY SAMPLING RESULTS

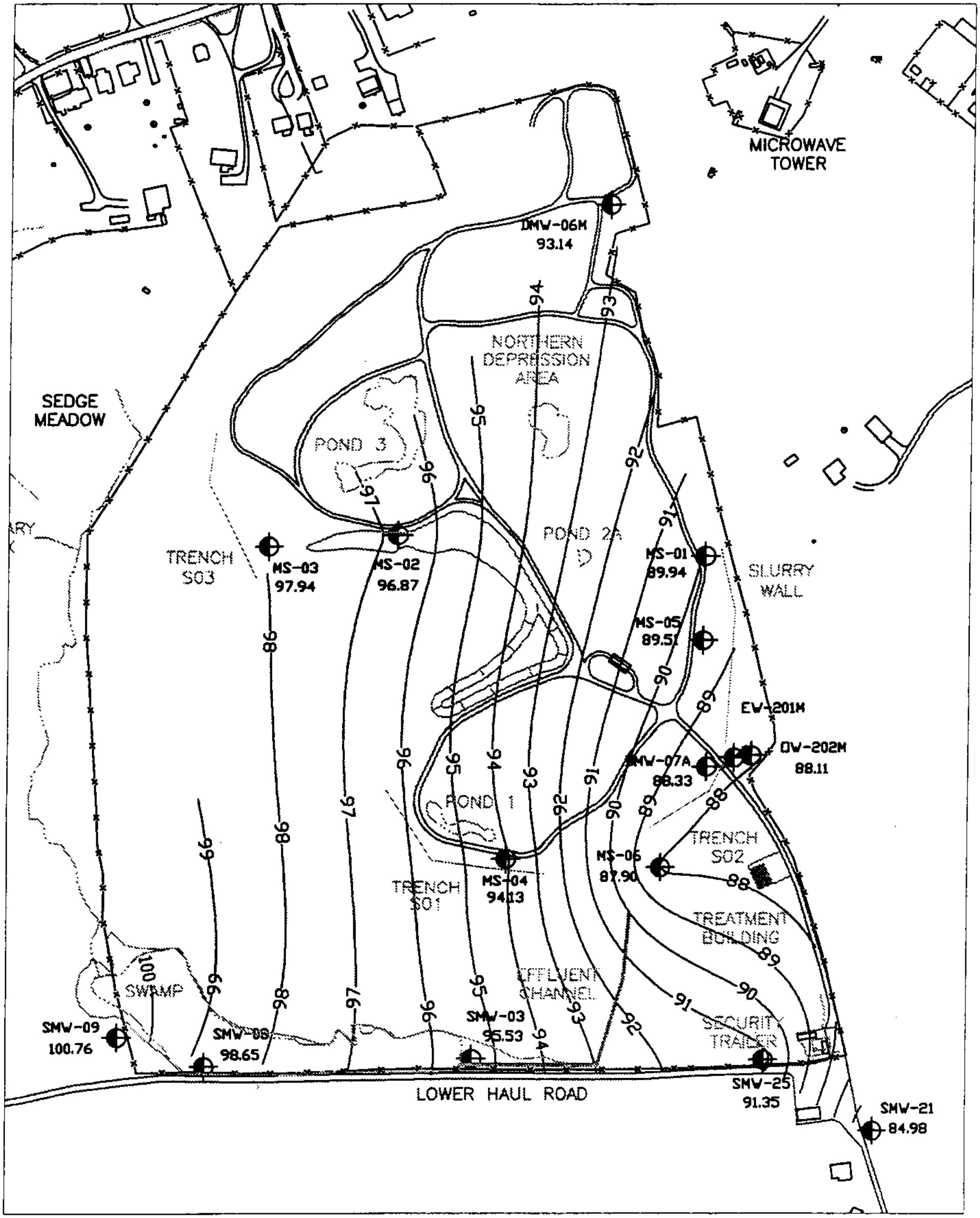
DISSOLVED METALS ANALYSIS - UPPER SAND GROUNDWATER SAMPLES (Semi-Annual)

WELL LOCATION	SMW-01		US-1		US-2		US-3		US-4		US-5		US-9		US-10		US-11	
EPA SAMPLE NO.	SMW-01		US-1		US-2		US-3		US-4		US-5		US-9		US-10		US-11	
DATE SAMPLED	11/07/01		11/07/01		11/07/01		11/07/01		11/07/01		11/07/01		11/07/01		11/07/01		11/07/01	
CONCENTRATION UNIT	ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l		ug/l	
Aluminum	239	B	444	B	177	B	132	B	112	B	121	B	128	B	101	B	241	B
Antimony	2.7	U	2.7	U	2.7	U	2.7	U	2.7	U	2.7	U	2.7	U	2.7	U	2.7	U
Arsenic	2	B	1.7	UL	1.7	UL	1.7	UL	11	B	25.2	L	3.2	B	115	L	9.2	B
Barium	42.3	J	15.4	J	21.1	J	18	J	41.9	J	37.7	J	56.3	J	79.7	J	85.6	J
Beryllium	0.4	B	0.39	B	0.49	B	0.77	B	0.5	B	0.36	B	0.32	B	0.31	B	0.27	B
Cadmium	0.17	U	0.17	U	0.51	B	0.39	B	0.36	B	0.42	B	0.35	B	0.79	B	0.67	B
Calcium	2610	J	3830	J	987	J	2850	J	13200		9100		12700		13000		8260	
Chromium	0.45	U	0.45	U	0.45	U	0.45	U	0.45	U	35.5		0.45	U	0.59	B	0.45	U
Cobalt	8.9	J	1.4	B	5.4	J	3.5	B	0.79	B	3.2	B	3.8	B	2.6	B	0.51	B
Copper	3.3	B	3.5	B	5.7	B	3.4	B	2.5	B	2.5	B	2.3	B	3.7	B	2.5	B
Iron	3490		74.9	B	18.8	B	2840		49400		64400		52900		137000		138000	
Lead	1.3	U	1.3	U	1.3	U	1.3	U	1.3	U	1.3	U	1.3	U	1.3	U	1.3	U
Magnesium	4460	J	1520	J	1530	J	3420	J	8030	J	11100	J	7920	J	11100	J	7370	J
Manganese	198		40.1		243		135		114		42.8		208		269		261	
Mercury	0.1	U	0.1	U	0.1	U	0.31	B	0.62		0.13	B	0.11	B	0.3	B	0.1	U
Nickel	4.1	B	2.6	B	3.7	B	4.9	B	0.95	B	7.6	B	3.5	B	2.1	B	2.4	B
Potassium	796	J	655	J	535	J	409	UL	1990	J	2740	J	1640	J	2090	J	1430	J
Selenium	2.9	UL	2.9	UL	2.9	UL	2.9	UL	2.9	UL	2.9	UL	2.9	UL	2.9	UL	2.9	UL
Silver	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U	0.85	U
Sodium	4600	J	10400		4500	J	4760	J	46700		96800		38700		44100		26200	
Thallium	7.3	UL	7.3	UL	7.3	UL	7.3	UL	7.3	UL	7.3	UL	7.3	UL	7.3	UL	7.3	UL
Vanadium	0.7	B	0.36	U	0.52	B	0.7	B	0.36	U	0.36	U	0.36	U	0.36	U	0.38	B
Zinc	35.7		5.4	B	13.1	J	7	B	2.2	U	18.8	J	15.6	J	11.3	B	8.9	B

NOTES:

(1) "U" = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
(2) "UJ" = Not detected. Quantitation limit may be inaccurate or imprecise.
(3) "UL" = Not detected. Quantitation limit is probably higher.
(4) "B" = Not detected. Not detected substantially above the level reported in laboratory or field blanks.
(5) "J" = Analyte present. Reported value may not be accurate or precise.
(6) "K"= Analyte present. Reported value may be biased high. Actual value is expected to be lower.
(7) "L" = Reported value may be biased low. Actual value is expected to be higher.

Appendix F
Middle Sand Ground Water Monitoring Locations, Potentiometric Surface Map, and Ground Water Quality Data



Baker	TITLE: Groundwater Contours Middle Sand – Nov. 2001 MSG&S, Elkton, MD	DWN: dsf	DES.: dsf	PROJECT NO.: 24004
		CHKD: jcb	APPD:	FIGURE NO.: 2
		DATE: 12/03/01	REV.: 0	

TABLE 8

MARYLAND SAND, GRAVEL, AND STONE SITE
PHASE I GROUNDWATER MONITORING PROGRAM
TWENTY-THIRD QUARTERLY SAMPLING RESULTS

VOLATILE ORGANICS ANALYSIS - MONITORING WELL OW-202M (Quarterly)

WELL LOCATION	OW-202M	
EPA SAMPLE NO.	OW-202M	
DATE SAMPLED	11/09/01	
CONCENTRATION UNIT	ug/l	
1,1,1-Trichloroethane	190	
1,1,2,2-Tetrachloroethane	10	U
1,1,2-Trichloroethane	1.3	J
1,1-Dichloroethane	90	
1,1-Dichloroethene	39	
1,2-Dichloroethane	10	U
1,2-Dichloroethene (Total)	12	
1,2-Dichloropropane	10	U
2-Butanone	10	U
2-Hexanone	10	U
4-Methyl-2-pentanone	10	U
Acetone	10	U
Benzene	8.6	J
Bromodichloromethane	10	U
Bromoform	10	U
Bromomethane	10	U
Carbon Disulfide	10	U
Carbon tetrachloride	10	U
Chlorobenzene	71	
Chlorodibromomethane	NA	
Chloroethane	28	
Chloroform	10	U
Chloromethane	10	U
cis-1,2-Dichloroethene	NA	
cis-1,3-Dichloropropene	10	U
Dibromochloromethane	10	U
Ethylbenzene	10	U
Methylene chloride	10	B
Styrene	10	U
Tetrachloroethene	1.4	J
Toluene	74	
trans-1,2-Dichloroethene	NA	
trans-1,3-Dichloropropene	10	U
Trichloroethene	3.7	J
Vinyl chloride	1.8	J
Xylene (total)	3.7	J

NOTES:
(1) "U" = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
(2) "B" = Not detected. Not detected substantially above the level reported in laboratory or field blanks.
(3) "J" = Analyte present. Reported value may not be accurate or precise.

TABLE 9

MARYLAND SAND, GRAVEL, AND STONE SITE
PHASE II GROUNDWATER MONITORING PROGRAM
THIRTY-SEVENTH QUARTERLY SAMPLING RESULTS

VOLATILE ORGANICS ANALYSIS - MIDDLE SAND GROUNDWATER SAMPLES (Quarterly)

WELL LOCATION	MS-1	MS-2	MS-3	MS-4	MS-5	MS-5 (Dup)	MS-6	SMW-25	DMW-06M	DMW-07A
EPA SAMPLE NO.	MS-1	MS-2	MS-3	MS-4	MS-5	MS-10D	MS-6	SMW-25	DMW-06M	DMW-07A
DATE SAMPLED	11/08/01	11/08/01	11/08/01	11/09/01	11/08/01	11/08/01	11/09/01	11/08/01	11/08/01	11/08/01
CONCENTRATION UNIT	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
1,1,1-Trichloroethane	10 U	7.3 J	99	10 U	10 U	10 U	84	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-Trichloroethane	10 U	10 U	10 U	10 U	10 U	10 U	1.1 J	10 U	10 U	10 U
1,1-Dichloroethane	10 U	21	81	10 U	10 U	10 U	130	10 U	10 U	10 U
1,1-Dichloroethene	10 U	10 U	3.1 J	10 U	10 U	10 U	4.4 J	10 U	10 U	10 U
1,2-Dichloroethane	10 U	1.1 J	2.5 J	10 U	10 U	10 U	6.3 J	10 U	10 U	10 U
1,2-Dichloroethene (Total)	10 U	9 J	12	10 U	10 U	10 U	40	10 U	10 U	10 U
1,2-Dichloropropane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Butanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Hexanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methyl-2-pentanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acetone	10 U	10 U	10 U	1 J	10 U	1.7 B	10 U	10 U	10 U	10 U
Benzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromodichloromethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromoform	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromomethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon Disulfide	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon tetrachloride	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroethane	10 U	8 J	40	10 U	10 U	10 U	47	10 U	10 U	10 U
Chloroform	10 U	10 U	1.2 J	10 U	10 U	10 U	1.8 J	2.4 J	10 U	10 U
Chloromethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibromochloromethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Ethylbenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methylene chloride	10 U	1 J	6 J	10 U	10 U	10 U	14	10 U	10 U	10 U
Styrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethene	10 U	1.5 J	6.8 J	10 U	10 U	10 U	7.2 J	10 U	10 U	10 U
Toluene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Trichloroethene	10 U	10 U	4.2 J	10 U	10 U	10 U	4.1 J	10 U	10 U	10 U
Vinyl chloride	10 U	10 U	10 U	10 U	10 U	10 U	1.7 J	10 U	10 U	10 U
Xylene (total)	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
cis-1,3-Dichloropropene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
trans-1,3-Dichloropropene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

NOTES:
(1) "U" = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
(2) "UJ" = Not detected. Quantitation limit may be inaccurate or imprecise.
(3) "B" = Not detected. Not detected substantially above the level reported in laboratory or field blanks.
(4) "J" = Analyte present. Reported value may not be accurate or precise.

TABLE 10

MARYLAND SAND, GRAVEL AND STONE SITE
PHASE II GROUNDWATER MONITORING PROGRAM
THIRTY-SEVENTH QUARTERLY SAMPLING RESULTS

DISSOLVED METALS ANALYSIS - MIDDLE SAND (Annual)

WELL LOCATION	MS-2	MS-3	MS-4	MS-5	MS-5 (Dup)	MS-6	SMW-25	DMW-06M	DMW-07A
EPA SAMPLE NO.	MS-2	MS-3	MS-4	MS-5	MS-10D	MS-6	SMW-25	DMW-06M	DMW-07A
DATE SAMPLED	11/9/00	11/9/00	11/9/00	11/9/00	11/9/00	11/10/00	11/8/00	11/9/00	11/9/00
CONCENTRATION UNIT	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Aluminum	109 B	105 B	133 B	208 B	144 B	304 B	168 B	233 B	176 B
Antimony	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U
Arsenic	1.7 UL	2.4 B	1.7 UL	1.7 UL	1.9 B	1.7 UL	1.7 UL	1.7 UL	1.7 UL
Barium	12 J	15.9 J	48.7 J	8.3 J	7.8 J	14.8 J	41.6 J	12.5 J	8 J
Beryllium	0.26 B	0.17 B	0.14 U	1.3 B	1.3 B	0.2 B	1.6 B	1.8 B	0.91 B
Cadmium	0.17 U	0.17 U	0.35 B	0.17 U	0.17 U	0.28 B	0.17 U	0.27 B	0.29 B
Calcium	2870 J	55100	7790	818 B	794 B	1770 J	2000 J	1190 J	874 B
Chromium	0.45 U	2.7 B	0.45 U	0.45 U	0.61 B	1.2 B	3 B	0.45 U	0.45 U
Cobalt	1.4 B	0.48 U	30 J	34.6 J	34.1 J	3.7 B	13.7 J	9.3 J	21 J
Copper	3.2 B	3 B	6.9 J	30.1	29.7	15.5 J	17.3 B	3.6 B	13.4 B
Iron	20.1 B	10.4 U	21.1 B	79.1 B	24.7 B	31.1 B	16.1 B	50.8 B	33.8 B
Lead	1.3 U	1.3 U	1.3 UL	1.3 U	1.3 U	1.3 UL	1.3 U	1.3 U	1.3 U
Magnesium	776 J	7350 J	188 B	301 B	286 B	858 J	851 J	512 B	306 B
Manganese	13 J	6.6 B	14.4 J	8.6 B	7.6 J	23.4	7.7 J	15.6	9.1 J
Mercury	0.1 B	0.1 U	0.1 U	0.1 U	0.1 U	0.14 J	0.1 U	0.1 U	0.1 U
Nickel	3.9 B	1.2 B	60.5	74.7	75.1	9.5 J	26.1 J	16.5 J	44
Potassium	491 J	1400 J	4240 J	299 J	239 B	880 J	91.4 B	266 J	254 J
Selenium	2.9 UL	2.9 UL	2.9 UL	2.9 UL	2.9 UL	2.9 UL	2.9 UL	2.9 UL	2.9 UL
Silver	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U
Sodium	3470 J	4940 J	17800	3640 J	3560 J	4470 J	3080 J	6080	2780 J
Thallium	7.3 UL	7.3 U	7.3 U	7.3 UL	7.3 UL	7.3 U	7.3 UL	7.3 UL	7.3 UL
Vanadium	0.69 B	60.3	0.36 U	0.66 B	0.36 U	0.36 U	0.88 B	0.47 B	0.36 U
Zinc	29.3	23.8	2080	130	83.1	5.7 B	25.2	21.6	49.2

NOTES:
(1) "U" = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
(2) "UJ" = Not detected. Quantitation limit may be inaccurate or imprecise.
(3) "UL" = Not detected. Quantitation limit is probably higher.
(4) "B" = Not detected. Not detected substantially above the level reported in laboratory or field blanks.
(5) "J" = Analyte present. Reported value may not be accurate or precise.
(5) "K"= Analyte present. Reported value may be biased high. Actual value is expected to be lower.

Appendix G
Identification of Principal Threat Material for Ground Water Protection

1.0 PRINCIPAL THREAT CRITERIA

The EPA document "Soil Screening Guidance: User's Guide" (EPA, 1996) presents a methodology for conservatively quantifying contaminant migration from soil to ground water. This method was utilized to estimate the contaminant concentrations in site soils that might have the potential to cause ground water concentrations to reach levels that may pose a cancer risk of 10^{-3} or a non-carcinogenic hazard index of 100. Soil concentrations were calculated using both the partitioning and the mass-limit equations. The mass-limit equation was determined to be the appropriate equation for the identified COCs.

The equations used to determine the principal threat criterion for each COC are presented below:

$Cs = (Cw * I * ED)/(\rho b * ds)$ (Eqn 14, p31)

where:

Cs = screening level in soil (mg/kg)

Cw = target soil leachate concentration (mg/L)

I = infiltration rate (m)

ED = 70 years (default)

ρb = 1.5 kg/L (default)

ds = 8 m (site-specific - about 25 ft)

The target soil leachate concentration, Cw, is equal to the ground water health-based limit (HBL) that would present a 10^{-3} cancer risk or a hazard index of 100 multiplied by a dilution factor that is calculated based upon the source geometry and the hydrogeologic characteristics of the site. The HBLs for each constituent were determined by multiplying the EPA Region 3 risk-based concentrations for tap water by a factor of 1000 for the carcinogens (adjusting from a 10^{-6} risk to a 10^{-3} risk) or a factor of 100 for the non-carcinogens (adjusting from a hazard index of 1 to a hazard index of 100).

Cw = Health-Based Level x Dilution Factor

The site-specific dilution factor was calculated as shown below.

$$DF = 1 + \frac{KiD}{IL} = 10.95 \qquad \text{(Eqn 10, p. 31)}$$

K = 14 ft/day (site-specific average of range of 3-25 ft/day)

i = 0.03 (site-specific taken from Jan 97 contour map)

D = 10 ft (site-specific average of saturated thickness)

I = 14 in (site-specific from Baker calibrated flow model)

L = 40 m (estimate of principal threat source area length)

The ground water health-based limits that correspond to a 10^{-3} cancer risk or hazard index of 100, and the resulting calculated soil principal threat concentrations are summarized in Table 1 below.

In response EPA's 3 January 2001 comment letter on the *Draft Identification of Principal Threat Material Report* (21 November 2000), additional screening of semivolatile compounds to determine whether additional constituents should be added to the list of constituents of concern that may present a principal threat to ground water. The results of this screening are presented in Appendix A. Based on the revised screening, no additional compounds were identified that should be added to the list of potential principal threat COCs.

Table 2 presents the calculations of the principal threat criteria for the compounds in Table 1 and also calculates principal threat criteria for the other constituents of concern to ground water to be used in the development of PRGs for the Site.

Table 1 *Results of Principal Threat Soil Criteria Calculations*

Constituent	Region III Tap Water RBC (ug/L)	Principal Threat Ground Water HBL (mg/L)	Principal Threat Soil Concentration (mg/kg)
1,1-dichloroethene	4.4e-02	4.4e-02	1
1,2-dichloroethane	1.2e-01	1.2e-01	2.7
Acetone	6.2e+02	6.2e+01	1400
Benzene	3.2e-01	3.2e-01	7.3
Chlorobenzene	1.1e+02	1.1+01	250
Chloroethane	3.6e+00	3.6e+00	82
Cis-1,2-dichloroethene	6.1e+01	6.1e+00	140
Methylene chloride	4.1e+00	4.1e+00	93
Methyl isobutyl ketone	1.4e+02	1.4e+01	320
Tetrachloroethene	1.1e+00	1.1e+00	25
Trichloroethene	1.6e+00	1.6e+00	36
Total 1,2-dichloroethene	5.5e+01	5.5e+00	-
Vinyl chloride	4.0e-02	4.0e-02	0.9

2.0 *ESTIMATION OF PRINCIPAL THREAT VOLUMES*

The distribution of soil concentrations exceeding the principal threat criteria was examined and principal threat volumes developed for twelve of the thirteen individual COCs. A volume was not generated for total 1,2-dichloroethene because that parameter is only provided in the database for a few samples and the distribution of cis-1,2-dichloroethene was considered to represent most of the risk associated with 1,2-dichloroethene.

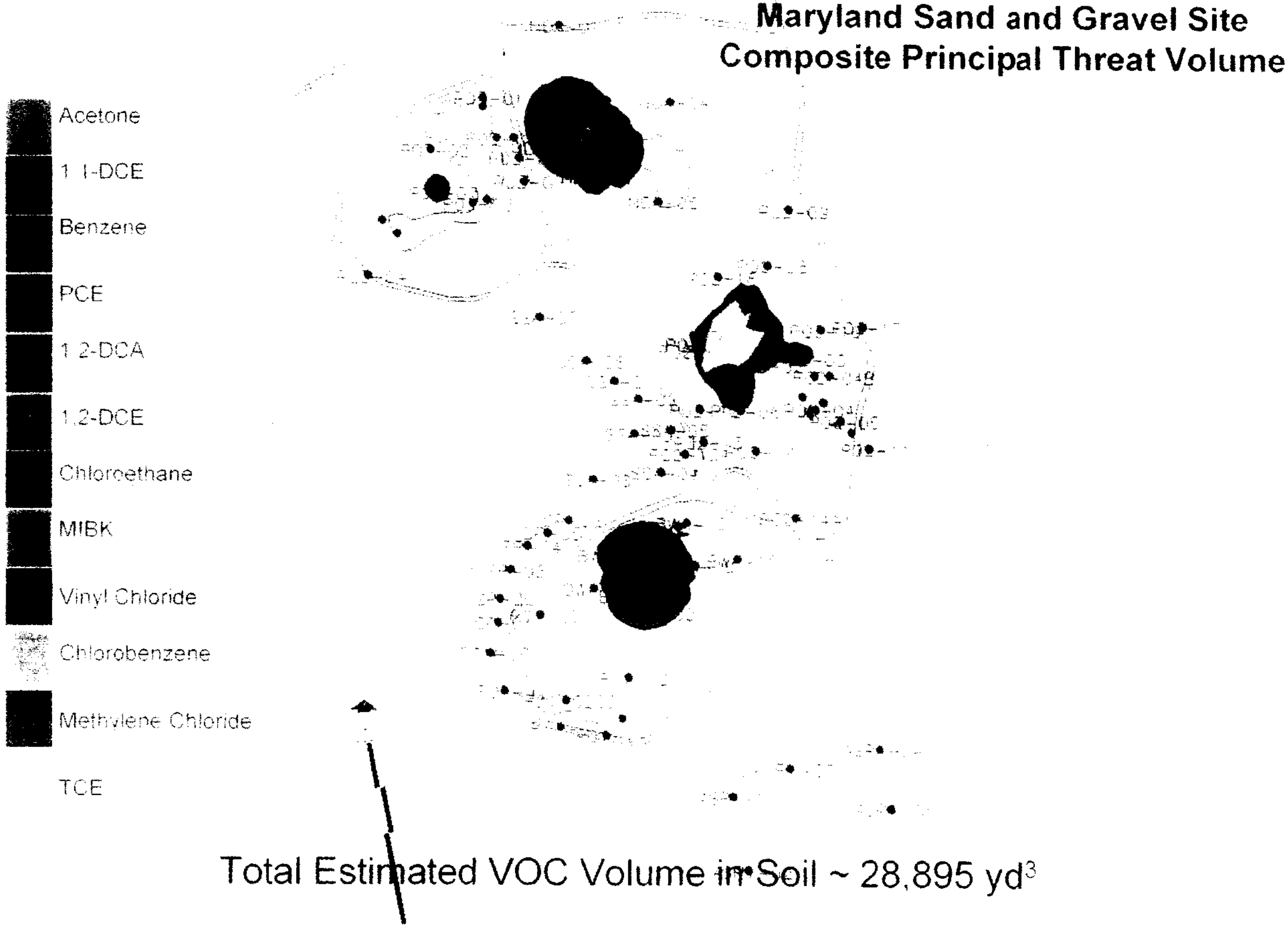
EVS-Pro software was utilized to facilitate interpolation of data and generate three-dimensional volumes for the multiple individual COCs. EVS-Pro is a geostatistical analysis and data visualization software package commercially available from C Tech. It uses kriging as its interpolation method for contouring data. Kriging is a stochastic technique similar to inverse distance weighted averaging in that it uses a linear combination of weights at known points to estimate the value at the grid nodes. Kriging is named after D.L. Krige, who used kriging's underlying theory to estimate ore content. Kriging uses a variogram (a.k.a. semivariogram) which is a representation of the spatial and data differences between some or all possible "pairs" of points in the measured data set. The variogram then describes the weighting factors that will be applied for the interpolation. Unlike other estimation procedures investigated, kriging provides a measure of the error and associated confidence in the estimates.

The distributions for the individual distributions were then overlain to develop an aggregate principal threat volume that represents the soil material which contains any of the individual COCs at a concentration that exceeds the calculated principal threat criteria.

The results of the visualization modeling displaying the aggregate volume of material exceeding the principal threat criterion for any of the COCs are presented in Figures 1 through 3.

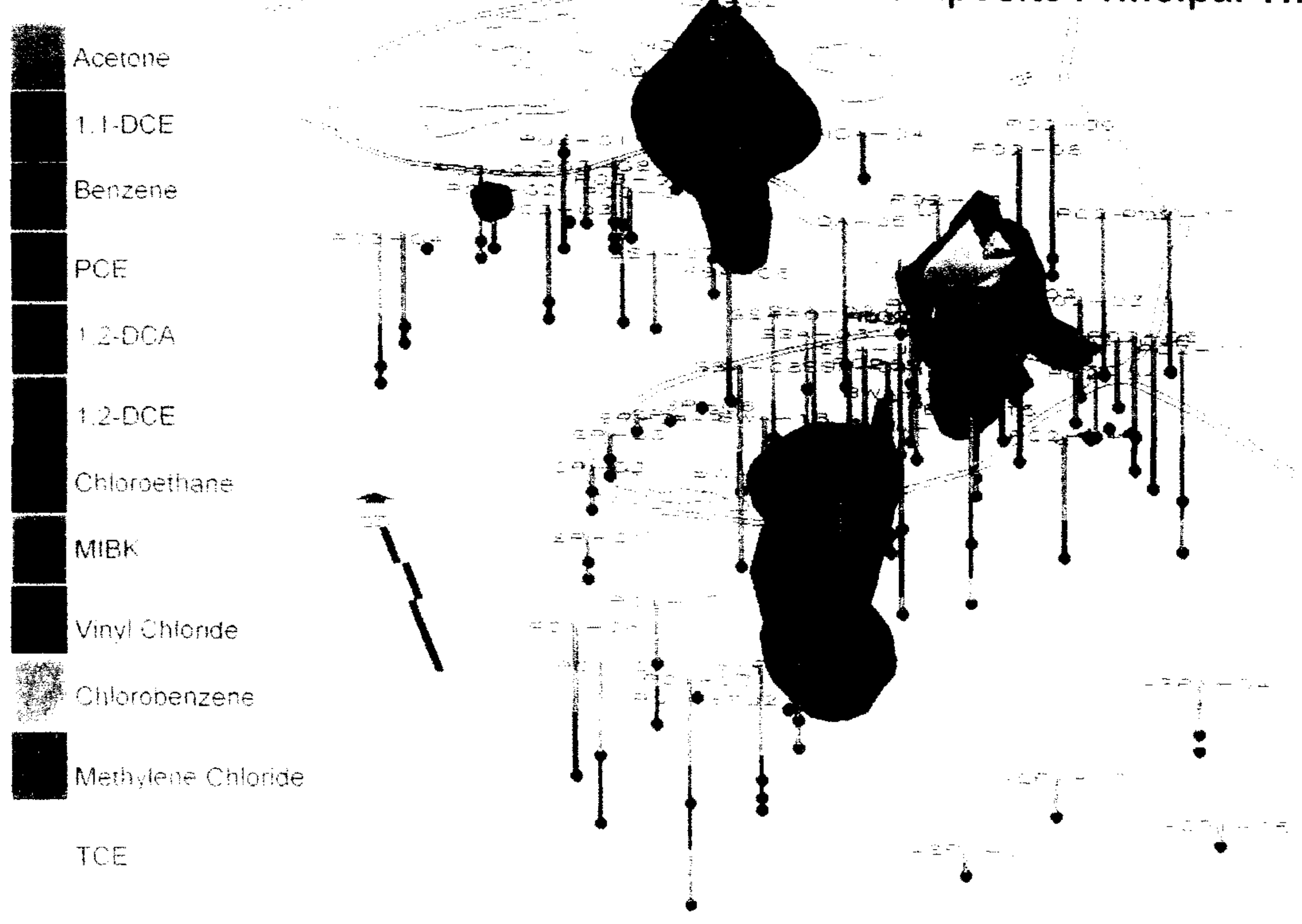
The total volume of principal threat material is estimated to be approximately 30,000 cubic yards, with approximately 23,000 cubic yards above the water table and 7,000 cubic yards below the water table.

Figure 1
Maryland Sand and Gravel Site
Composite Principal Threat Volume



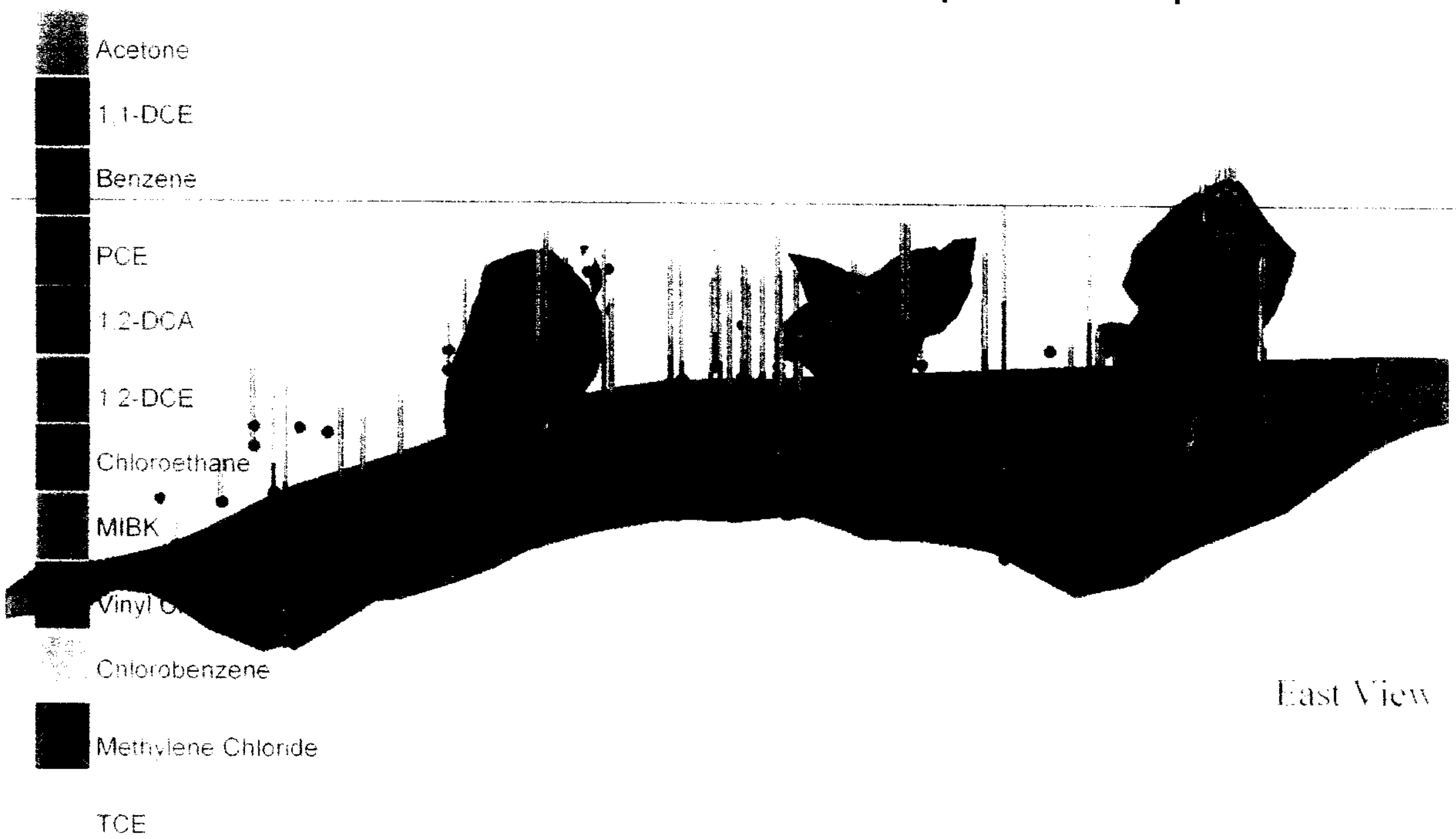
Total Estimated VOC Volume in Soil ~ 28,895 yd^3

Figure 2
Maryland Sand and Gravel Site
Composite Principal Threat Volume



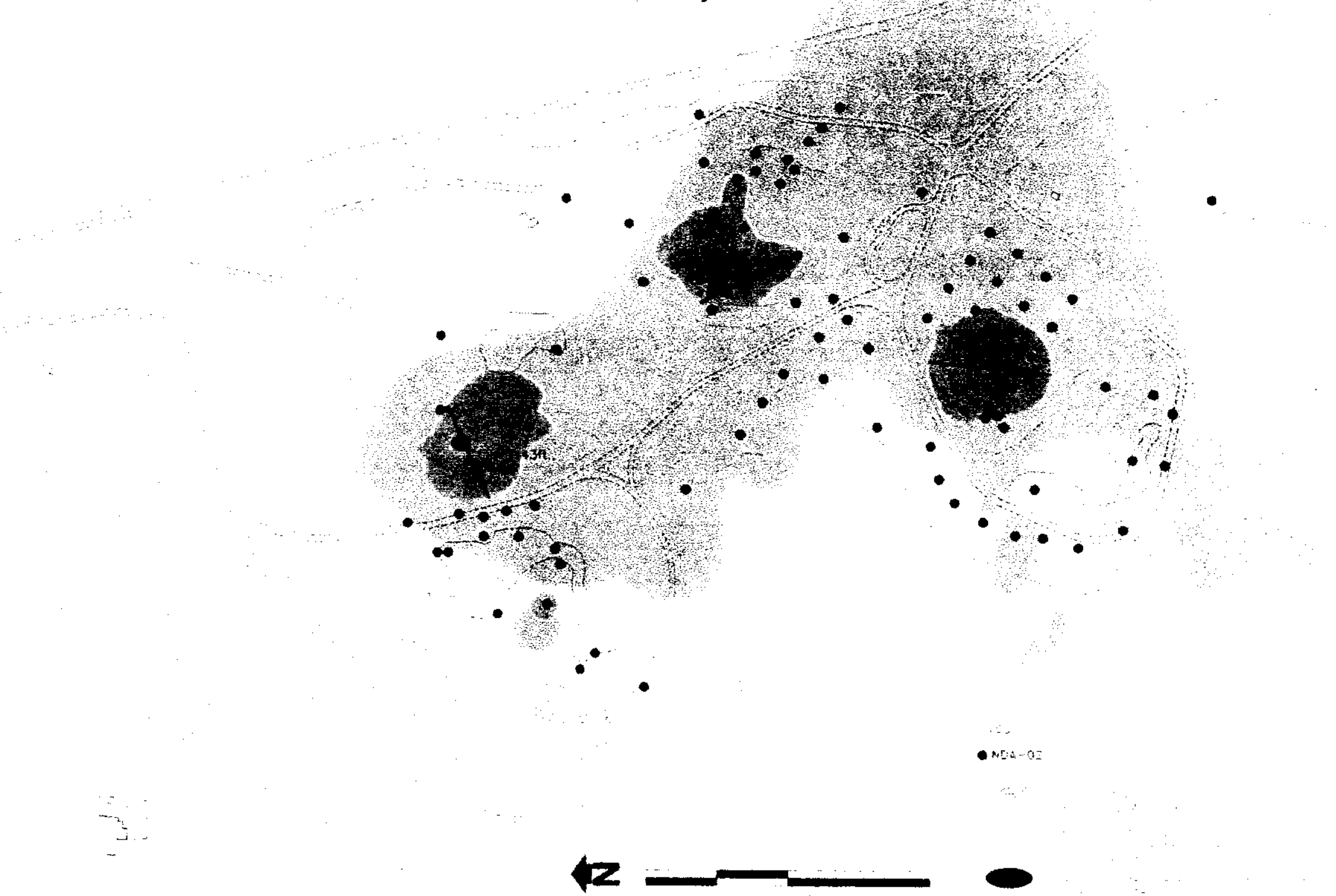
Total Estimated VOC Volume in Soil ~ 28,895 yd^3

Figure 3
Maryland Sand and Gravel Site
Composite Principal Threat Volume



Total Estimated VOC Volume in Soil ~ 28,895 yd^3

Figure 4
Principal Threat Source Length
Maryland Sand, Gravel, and Stone
Elkton, Maryland



2.1 DATA CONSIDERATIONS

Table 3 indicates which COCs exceed the principal threat criteria at each sample location.

In developing the data sets for modeling, non-detect results were assigned a value of half the detection limit, except in cases where half the detection limit would be in excess of the principal threat criteria. In cases where half the detection limit would cause an exceedance of the principal threat criteria, a potential false positive, these non-detect values were not included in the data set for modeling.

A complete listing of the data used in the modeling effort is provided in the final *Identification of Principal Threat Material Report.*

An initial estimate of the source length is required to estimate the dilution factor needed to calculate the Principal Threat criteria. An initial estimate of 40 meters was used. Once the Principal Threat criteria values are determined, the model contours the data to estimate the areal extent of the source. If the contoured length of the source is significantly different than the initial estimate then the dilution factor and Principal Threat criteria can be adjusted until the contoured source length approaches the estimated source length. Figure 4 shows the contoured source length for each of the source areas. The contoured source lengths ranged from 44 to 53 meters, which was believed to be close enough to the initial estimate of 40 meters.

2.2 MODELING

Settings for modeling were generally left at the default values as specified by EVS-Pro. Significant model settings are summarized below:

- Anisotropy set at the default value of 10.
- Reach set by EVS.
- Points doubled from 20 to 40 for Benzene, 1,2-DCA.
- Color scale defined by the maximum concentration in the data set.

X, Y resolution increased from 21 by 21 to 61 by 121 for PCE, 1,1-DCE and Benzene.

Table 2

Summary of Soil Screening Levels to meet Principal Threat in Upper Sand for Compounds of Concern (Principal Threat Area)

Maryland Sand, Gravel, and Stone Site
Elkton, Maryland

Compounds of Concern	*Partitioning-Based* Soil Screening Level (SSL) to meet PT (mg/kg)	*Mass-Limited* Soil Screening Level (SSL) to meet PT (mg/kg)	*Higher SSL to meet* Principal Threat at $1x10^{-4}$ (HI=100) (mg/kg)
Volatile Organics (mg/kg)			
1,1,1-trichloroethane	1.62E+03	7.27E+03	7271.48
1,1-Dichloroethane	2.04E+02	1.82E+03	1817.87
1,1-Dichloroethylene	2.01E-01	1.00E+00	1.00
1,3-Dichlorobenzene	2.99E+00	1.25E+01	12.50
1,2-dichloroethane	2.29E-01	2.73E+00	2.73
acetone	9.00E+01	1.39E+03	1386.13
benzene	1.00E+00	7.27E+00	7.27
chlorobenzene	7.17E+01	2.50E+02	249.96
chloroethane	8.56E+00	8.18E+01	81.80
cis-1,2-dichloroethylene	1.54E+01	1.39E+02	138.61
methylene chloride	7.67E-01	9.32E+00	9.32
methyl ethyl ketone	2.78E+02	4.32E+03	4317.44
methyl isobutyl ketone	2.06E+01	3.18E+02	318.13
tetrachloroethene	1.18E+01	2.50E+01	25.00
toluene	6.37E+02	1.70E+03	1704.25
total 1,2-dichloroethene	1.39E+01	1.25E+02	124.98
trans 1,2-dichloroethene	3.92E+01	2.73E+02	272.68
trichloroethene	1.02E+01	3.64E+01	36.36
vinyl chloride	1.51E-01	9.09E-01	0.91
Semi-volatiles (mg/kg)			
1,4-dichlorobenzene	7.12E-01	1.07E+00	1.07
2-chlorophenol	3.00E+01	6.82E+01	68.17
acetophenone	8.10E-03	9.54E-02	0.10
naphthalene	2.95E+01	1.48E+01	29.45

Potential Human Carcinogen

Table 2 (Continued)

Mass Limited Soil Screening Levels (Principal Threat)

for Compounds of Concern

Maryland Sand, Gravel, and Stone Site

Elkton, Maryland

Dilution Attenuation Factor (DAF) = 1 + (Kid/IL)

where: K = aquifer hydraulic conductivity (m/yr)
i = hydraulic gradient (m/m)
d = mixing zone depth (m)

where: $d = (0.0112\,L^2)^{0.5} + d_a\,\{1-\exp[-LI)/Kid_a)]\}$

where: d_a = aquifer thickness (m)

I = infiltration rate (m/yr)
L = source length parallel to ground water flow (m)

	Variables				DAF
K* (m/yr)	i (m/m)	d_a (m)	I (l)	L (m)	
1557.53	0.03	3.048	0.3556	40.2336	10.9545

v=Ki 46.7258 m/yr

*Screening Level in Soil (mg/kg) = $(C_w$*I*ED)/(ρb*ds)*

where: C_w = target soil leachate concentration (mg/L)
I = infiltration (m/yr)
ED = exposure duration (yrs)

ρ_b = dry soil bulk density (kg/L)
ds = depth of source (m)

Compounds of Concern	Variables of SSL Equation						
	Tap Water RBC modified(mg/L)	DAF [1]	Cw	I	ED	ρb	ds (m)	SSL (mg/kg)
Inorganics (mg/kg)								
Volatile Organics (mg/kg)								
1,1,1-trichloroethane	320	10.9545	3505.45	0.3556	70	1.5	8	7271.48
1,1,2-trichloroethane	*0.19*	*10.9545*	*2.08136*	*0.3556*	*70*	*1.5*	*8*	4.31744
1,1-Dichloroethane	80	10.9545	876.364	0.3556	70	1.5	8	1817.87030
1,1-Dichloroethylene	*0.044*	*10.9545*	*0.482*	*0.3556*	*70*	*1.5*	*8*	1.00
1,3-Dichlorobenzene	0.55	10.9545	6.025	0.3556	70	1.5	8	12.50
1,2-dichloroethane	0.12	10.9545	1.31455	0.3556	70	1.5	8	2.73
acetone	61	10.9545	668.227	0.3556	70	1.5	8	1386.13
benzene	0.32	10.9545	3.50545	0.3556	70	1.5	8	7.27
chlorobenzene	11	10.9545	120.5	0.3556	70	1.5	8	249.96
chloroethane	3.6	10.9545	39.4364	0.3556	70	1.5	8	81.80
cis-1,2-dichloroethylene	6.1	10.9545	66.8227	0.3556	70	1.5	8	138.61
methylene chloride	0.41	10.9545	4.49136	0.3556	70	1.5	8	9.32
methyl ethyl ketone	190	10.9545	2081.36	0.3556	70	1.5	8	4317.44
methyl isobutyl ketone	14	10.9545	153.364	0.3556	70	1.5	8	318.13
tetrachloroethene	1.1	10.9545	12.05	0.3556	70	1.5	8	25.00
toluene	75	10.9545	821.591	0.3556	70	1.5	8	1704.25
total 1,2-dichloroethene	5.5	10.9545	60.25	0.3556	70	1.5	8	124.98
trans 1,2-dichloroethene	12	10.9545	131.455	0.3556	70	1.5	8	272.68
trichloroethene	1.6	10.9545	17.5273	0.3556	70	1.5	8	36.36
vinyl chloride	0.04	10.9545	0.43818	0.3556	70	1.5	8	0.91
Semi-volatiles (mg/kg)								
1,4-dichlorobenzene	0.047	10.9545	0.51486	0.3556	70	1.5	8	1.07
2-chlorophenol	3	10.9545	32.8636	0.3556	70	1.5	8	68.17
acetophenone	0.0042	10.9545	0.04601	0.3556	70	1.5	8	0.095438
naphthalene	0.65	10.9545	7.12045	0.3556	70	1.5	8	14.77

[1] The DAF calculation is based on the Soil Screening Guidance: Technical Background Document (May 1996), Section 2.5.5, page 44, equation 37.

K value is the mean of the hydraulic conductivities used in Baker's flow model for the transmissive zones (3 fpd to 25 fpd).
i value is the gradient between Pond 2 wet and Trench 2 ((146 ft - 130 ft)/540 ft) = 0.03 (from Jan 1997 GW contour map)
d value is the average saturated thickness for the upper sand (mixing zone limited to aquifer saturated thickness)
I value is the net recharge rate from the Baker's calibrated flow model (14 inches).
L value is the distance of the ground water flow path through the source area (see figure)

Table 3
Soil Concentrations Exceeding Principal Treat Criteria

Location	Depth	COC	Conc (ppb)	x	y	Surf Elev
Buried Waste Area						
BWA-01	11	Chlorobenzene	670000	1623534	711854	154.3
BWA-01	11	PCE	350000	1623534	711854	154.3
BWA-01	11	TCE	200000	1623534	711854	154.3
BWA-01	16.5	1,1-DCE	15000	1623534	711854	154.3
BWA-01	16.5	Benzene	30000	1623534	711854	154.3
BWA-01	16.5	Chlorobenzene	3000000	1623534	711854	154.3
BWA-01	16.5	MIBK	370000	1623534	711854	154.3
BWA-01	16.5	PCE	2000000	1623534	711854	154.3
BWA-01	16.5	TCE	1000000	1623534	711854	154.3
BWA-01	17	1,1-DCE	23000	1623534	711854	154.3
BWA-01	17	Benzene	51000	1623534	711854	154.3
BWA-01	17	Chlorobenzene	3300000	1623534	711854	154.3
BWA-01	17	MeCl	170000	1623534	711854	154.3
BWA-01	17	MIBK	450000	1623534	711854	154.3
BWA-01	17	PCE	2900000	1623534	711854	154.3
BWA-01	17	TCE	1100000	1623534	711854	154.3
BWA-18	9	Chlorobenzene	390000	1623502	711920	158
BWA-18	9	PCE	470000	1623502	711920	158
BWA-18	9	TCE	40000	1623502	711920	158
Northern Depression Area						
EP-1	22	PCE	136337	1623450	712587	163.8
EP-1	26	TCE	294760	1623450	712587	163.8
NDA-02	8	Acetone	4000000	1623453	712628	166.2
NDA-02	8	Benzene	2300000	1623453	712628	166.2
NDA-02	8	Chlorobenzene	270000000	1623453	712628	166.2
NDA-02	8	Chloroethane	2850000	1623453	712628	166.2
NDA-02	8	cis 1,2 DCE	2850000	1623453	712628	166.2
NDA-02	8	MeCl	1700000	1623453	712628	166.2
NDA-02	8	MIBK	2850000	1623453	712628	166.2
NDA-02	8	PCE	110000000	1623453	712628	166.2
NDA-02	8	TCE	14000000	1623453	712628	166.2
NDA-02	12.2	Acetone	4400000	1623453	712628	166.2
NDA-02	12.2	Benzene	1300000	1623453	712628	166.2
NDA-02	12.2	Chlorobenzene	112000000	1623453	712628	166.2
NDA-02	12.2	Chloroethane	2650000	1623453	712628	166.2
NDA-02	12.2	cis 1,2 DCE	2650000	1623453	712628	166.2
NDA-02	12.2	MeCl	1500000	1623453	712628	166.2
NDA-02	12.2	MIBK	4400000	1623453	712628	166.2
NDA-02	12.2	PCE	51000000	1623453	712628	166.2
NDA-02	12.2	TCE	7000000	1623453	712628	166.2
NDA-03	17.5	MeCl	1000000	1623475	712534	159.1
NDA99-03	6	PCE	353312	1623460	712598	165.1
NDA99-03	6	TCE	35524	1623460	712598	165.1
NDA99-03	10	PCE	41372	1623460	712598	165.1
NDA99-03	14	PCE	242580	1623460	712598	165.1
NDA99-03	14	TCE	59529	1623460	712598	165.1
NDA99-03	18	PCE	1811730	1623460	712598	165.1
NDA99-03	18	TCE	448876	1623460	712598	165.1
NDA99-03	18	1,1-DCE	18080.9	1623460	712597	165.1

Table 3
Soil Concentrations Exceeding Principal Treat Criteria

NDA99-04	6	1,1-DCE	11578	1623456	712614	166.5
NDA99-04	6	Benzene	56506	1623456	712614	166.5
NDA99-04	6	Chlorobenzene	380000	1623456	712614	166.5
NDA99-04	6	PCE	2948924	1623456	712614	166.5
NDA99-04	6	PCE	160000	1623456	712614	166.5
NDA99-04	6	TCE	482259	1623456	712614	166.5
NDA99-04	10	PCE	35892	1623456	712614	166.5
NDA99-04	18	1,1-DCE	27559	1623456	712614	166.5
NDA99-04	18	Benzene	241509	1623456	712614	166.5
NDA99-04	18	PCE	2478853	1623456	712614	166.5
NDA99-04	18	TCE	727811	1623456	712614	166.5
NDA99-05	10	1,1-DCE	79637	1623454	712624	167
NDA99-05	10	Benzene	529411	1623454	712624	167
NDA99-05	10	PCE	12884178	1623454	712624	167
NDA99-05	10	TCE	2984144	1623454	712624	167
NDA99-05	14	1,1-DCE	178293	1623454	712624	167
NDA99-05	14	Benzene	877365	1623454	712624	167
NDA99-05	14	cis 1,2 DCE	171562	1623454	712624	167
NDA99-05	14	PCE	21099125	1623454	712624	167
NDA99-05	14	TCE	4807365	1623454	712624	167
NDA99-05	18	1,1-DCE	127291	1623454	712624	167
NDA99-05	18	1,1-DCE	2900	1623454	712624	167
NDA99-05	18	Benzene	1100000	1623454	712624	167
NDA99-05	18	Benzene	677124	1623454	712624	167
NDA99-05	18	Chlorobenzene	43000000	1623454	712624	167
NDA99-05	18	MeCl	5100000	1623454	712624	167
NDA99-05	18	MIBK	21000000	1623454	712624	167
NDA99-05	18	PCE	29000000	1623454	712624	167
NDA99-05	18	PCE	18504772	1623454	712624	167
NDA99-05	18	TCE	6500000	1623454	712624	167
NDA99-05	18	TCE	4019459	1623454	712624	167
NDA99-06	14	PCE	104121	1623448	712627	167
NDA99-06	18	Benzene	27449.5	1623448	712627	167
NDA99-06	18	PCE	435513	1623448	712627	167
NDA99-06	18	TCE	119899	1623448	712627	167
NDA99-06	18	1,1-DCE	4265	1623448	712627.2	167
NDA99-07	10	PCE	58374	1623473	712632	166.7
NDA99-07	14	Benzene	16630.5	1623473	712632	166.7
NDA99-07	14	PCE	886973	1623473	712632	166.7
NDA99-07	14	TCE	138793	1623473	712632	166.7
NDA99-08	14	1,1-DCE	14066.9	1623450	712642	164.4
NDA99-08	14	Benzene	55099.6	1623450	712642	164.4
NDA99-08	14	PCE	1417078	1623450	712642	164.4

Table 3
Soil Concentrations Exceeding Principal Treat Criteria

NDA99-08	18	PCE	32755	1623450	712642	164.4
Pond 1						
P01-03	14.5	MeCl	330000	1623425	711641	143.2
P01-03	26.5	MeCl	130000	1623425	711641	143.2
Pond 2						
P02-01	11	1,1-DCE	12000	1623690	712224	155.8
P02-01	11	Benzene	35000	1623690	712224	155.8
P02-01	11	PCE	73000	1623690	712224	155.8
P02-01	11	VC	970	1623690	712224	155.8
P02-01	15.5	1,1-DCE	6500	1623690	712224	155.8
P02-02	11.5	MeCl	450000	1623756	712231	154.8
P02-02	12.5	MeCl	330000	1623756	712231	154.8
P02-03	6	PCE	630000	1623824	712241	153.4
P02-03	6	TCE	95000	1623824	712241	153.4
P02-04	7.5	Chlorobenzene	390000	1623839	712159	149.6
P02-04	7.5	MeCl	550000	1623839	712159	149.6
P02-04	7.5	PCE	150000	1623839	712159	149.6
P02-04B	8	1,1-DCE	1800	1623862	712213	150.4
P02-05	12	MeCl	360000	1623879	712140	155.1
P02-06	13.5	Benzene	13000	1623718	712156	159.2
P02-13A	13.5	Benzene	8000	1623628	712085	154.9
P0299-02	1.5	Benzene	9600	1623662	712265	150
P0299-02	1.5	Chlorobenzene	1200000	1623662	712265	150
P0299-02	1.5	PCE	1100000	1623662	712265	150
P0299-02	1.5	TCE	480000	1623662	712265	150
P0299-02	4.5	PCE	170000	1623662	712265	150
P0299-04	6	PCE	43000	1623675	712259	149.6
P0299-05	6	PCE	136113	1623685	712275	150
P0299-05	6	TCE	92205	1623685	712275	150
P0299-05	6	1,1-DCE	2448.6	1623685	712274	150
P0299-05	6	Benzene	8804	1623685	712275	150
P0299-05	10	Benzene	8066.6	1623685	712275	150
P0299-05	10	PCE	209797	1623685	712275	150
P0299-05	10	TCE	116235	1623685	712275	150
P0299-05	10	1,1-DCE	3031.4	1623685	712274	150
P0299-06	2	Benzene	20517	1623692	712254	152
P0299-06	2	PCE	2318447	1623692	712254	152
P0299-06	2	TCE	1059630	1623692	712254	152
P0299-06	6	1,1-DCE	5750.8	1623685	712274	152
P0299-06	6	Benzene	11008.5	1623692	712254	152
P0299-06	6	PCE	327346	1623692	712254	152

Table 3
Soil Concentrations Exceeding Principal Treat Criteria

P0299-06	6	TCE	146885	1623692	712254	152
P02-SS01W	0	Benzene	24000	1623663	712253	150.5
P02-SS01W	0	Chlorobenzene	1700000	1623663	712253	150.5
P02-SS01W	0	Chloroethane	140000	1623663	712253	150.5
P02-SS01W	0	cis 1,2 DCE	140000	1623663	712253	150.5
P02-SS01W	0	PCE	1200000	1623663	712253	150.5
P02-SS01W	0	TCE	420000	1623663	712253	150.5
P02-SS02W	0	Benzene	130000	1623676	712263	150.1
P02-SS02W	0	Chlorobenzene	11000000	1623676	712263	150.1
P02-SS02W	0	Chloroethane	440000	1623676	712263	150.1
P02-SS02W	0	cis 1,2 DCE	440000	1623676	712263	150.1
P02-SS02W	0	MeCl	440000	1623676	712263	150.1
P02-SS02W	0	MIBK	520000	1623676	712263	150.1
P02-SS02W	0	PCE	7900000	1623676	712263	150.1
P02-SS02W	0	TCE	3000000	1623676	712263	150.1
Pond 3						
P03-G2	3	Chlorobenzene	580000	1623226	712508	150.7
P03-G2	3	PCE	650000	1623226	712508	150.7

3.'6 01

Appendix H
Summary of Material to be Addressed and Treatment Standards for Remedial Alternatives

Table 2-10
Summary of Material to be Addressed and Treatment Standards for Remedial Alternatives

	Remediation Strategy	Material to be Treated (or Removed)	Treatment Standards for Soils	*Alternatives* 1	2	3a	3b	3c	4a	4b	5
1	In-situ Treatment No cap	G.W.P.T., D.C.P.T., and D.C.L-L.T.[3]	- Direct Contact[1]: $1x10^{-6}$, HI = 1 - Ground Water Targets[2]: MCLs, non-zero MCLGs, $1x10^{-4}$, HI = 1				X	X			
2	Ex-situ Treatment No Cap	G.W.P.T., D.C.P.T., and D.C.L-L.T.[3]	- Direct Contact[1]: $1x10^{-6}$, HI = 1 - Ground Water Targets[2]: MCLs, non-zero MCLGs, $1x10^{-4}$, HI = 1 - Regulatory: RCRA UTSs for soil			X		X			X
3	In-situ Treatment, Cap	G.W.P.T., D.C.P.T.	- Direct Contact[1]: $1x10^{-3}$, HI = 100 - Ground Water Targets[2]: $1x10^{-3}$, HI = 100							X	
4	Ex-situ Treatment Cap	G.W.P.T., D.C.P.T.	- Direct Contact[1]: $1x10^{-4}$*, HI = 1* - Ground Water Targets[2]: MCLs*, $1x10^{-4}$*, HI = 1* - Regulatory: RCRA UTSs for soils						X		
5	Hot Spot Removal Cap	Column A in Table 2-3	- Off-site		X						

Notes: G.W.P.T. - Ground Water Principal Threat material, as defined in the FFS
D.C.P.T. - Direct Contact Principal Threat material, as defined in the FFS
D.C.L-L.T. - Direct Contact Low-Level Threat material, as defined in the FFS

1) Corresponding soil concentrations will be based on the methodology for calculating risk to an on-site resident in the May 2000 BLRA and the August 2000 BLRA Addendum. Soil below the water table would be required to attaina cumulative direct contact cancer risk of 10^{-4}.

2) Soil concentrations which would result in these target ground water concentrations are to be calculated using the methodology in EPA's *Soil Screening Guidance: User's Guide*, April 1996.

3) Ground Water Low-Level Threat material, as defined in the FFS, would also be treated under Alternative 5 in the FFS.

4) The cleanup standard for arsenic (and any other metals for which the risk-based level is below the background range) will be set at background. Arsenic may then be removed from the risk calculations when determining attainment/nonattainment of the risk-based cleanup objective (e.g., 10-4 or 10-6) for remaining COCs.

The soil treatment standards for remediation stratagies 1 and 2 would allow future use of the site by eliminating unacceptable direct contact risks. These standards would also ensure that soils would not continue to act as source of unacceptable levels of ground water contamination and would increase the probability of the successful bioremediation of the existing ground water contamination. Ground water use would need to be restricted until the ground water cleanup levels were achieved.

Generally, less stringent cleanup standards are appropriate for alternatives which include contaminent (cap and slurry wall) of the low-level threat material. Remediation strategy 3 would provide a level of treatment sufficient to eliminate principal threat material; the remaining low-level threat material would be contained. Additional treatment would be required for remediation strategy 4 which would trigger RCRA requirements due to the ex situ handling of soils containing hazardous waste. The treated soils would need to meet site-specific health-based levels, noted above (*), and UTSs for soils before a "contained-in determination" could be made and the material placed back onsite. Remediation strategy 5 would not remove *all* Ground Water Principal Threat material, but would provide containment of Ground Water Principal Threat and Ground Water Low-Level Threat material.

CLEAN SITES

Environmental Services, Inc.

February 25, 2002

Ms. Debra Rossi
Remedial Project Manager
Hazardous Substance Cleanup Division
U.S. Environmental Protection Agency
Region III (3HS23)
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Re: Maryland Sand, Gravel and Stone Site
Technical Comments To The National Remedy Review Board

Dear Ms. Rossi:

On behalf of the Settling Group of Potentially Responsible Parties for the Maryland Sand Gravel and Stone Superfund Site, please find enclosed 32 copies of the final ***Technical Comments To The National Remedy Review Board***. We would be pleased to meet with you and your management team to discuss enabling future productive Site reuse with the implementation of Alternative 2.

Should you have any questions, please do not hesitate to contact me at 703-519-2135.

Sincerely yours,

Douglas C. Ammon

Douglas C. Ammon, PE

Enclosure
cc:
David Healy, MDE
Marcia Preston, Esq.
Technical Committee
Legal Committee

TECHNICAL COMMENTS TO THE NATIONAL REMEDY REVIEW BOARD BY THE SETTLING PRP GROUP MARYLAND SAND, GRAVEL & STONE SUPERFUND SITE FEBRUARY 12, 2002

1.0 INTRODUCTION

The Settling Group of Potentially Responsible Parties ("Settlors") for the Maryland Sand Gravel and Stone Superfund Site (the "Site") appreciates the opportunity to present these comments to the National Remedy Review Board regarding critical issues concerning the selection of an appropriate remedy for the Site. The Settlors have performed the Remedial Investigation and Focused Feasibility Study for Operable Unit 3 ("OU3") as well as earlier investigations and remedial actions for Operable Units 1 and 2 ("OU1" and "OU2") at the Site. We understand that EPA Region III currently prefers remedial Alternative 3a as presented in the December 2001 revision of the Focused Feasibility Study ("FFS").

As discussed below, the Settlors believe that Alternative 2 (or variations on that alternative) is superior to Alternative 3a, considering the nine criteria specified in the National Contingency Plan ("NCP"). For example, Alternative 2: (1) is as protective and ARAR compliant as Alternative 3a; (2) is more cost-effective than Alternative 3a; and (3) would promote productive future land use that would be beneficial to the community and consistent with Maryland's SmartGrowth program. Table 1 is a summary which compares Alternatives 2 and 3a against each of the NCP's nine criteria.

A key assumption made by EPA in commenting on earlier versions of the Focused Feasibility Study and shaping the remedies considered therein is that residential development of the contaminated portion of the Site will occur resulting in consumption of the perched shallow (Upper Sand) ground water aquifer and direct contact with contaminated subsurface soils from intrusive construction activities and subsequent unrestricted residential or commercial use. The Settlors believe that this central premise is unreasonable and should not drive the remedy selection for the Site. This single assumption increases remedial costs by approximately $9 million.

Nor is this assumption necessary for productive future uses of the Site. The contaminated areas of the Site include approximately 18 acres of the 153 acre property – or 12%. The soils which present a direct contact risk (assuming intrusive construction and contact with subsurface soils) is limited to 1.5 acres or 1% of the Site. The only contaminated groundwater zone is the shallow Upper Sand aquifer, which itself is perched, limited in extent to approximately one-half the Site area, and probably would not be used as a potable water source even in the absence of Superfund issues. Alternative 2 limits ground water consumption and intrusive construction activity for the 18-acre capped area but not for the remaining 137 acres at a significant cost savings over Alternative 3a.

As shown below, the Site could support a number of future uses that would be valuable to the community. Because the contamination is limited to a relatively small area in one portion of the Site, the lower cost Alternative 2 would not preclude or be inconsistent with any of the potential land uses that would be desirable to the community, including but not limited to recreation, green space and development uses.

2.0 CONSISTENCY OF OPERABLE UNITS

The Settlors have fully cooperated with EPA, funding investigations, remedial measures, and EPA's oversight costs for the first two Operable Units. The Settlors have spent over $14.6 million to date implementing the remedies for OU1 and OU2 and another $4.4 Million for two RI/FSs (including the current FFS) and other EPA-requested studies.

The Settlors believe that Operable Unit 3 should continue in a cooperative manner with good faith efforts among the EPA, MDE, and the Settlors to implement a cost-effective risk management strategy that builds on OU1 and OU2. Under OU1 the Settlors have removed source material (buried drums), eliminated contaminated ground water seep discharges, continue to extract and treat contaminated ground water from the perched Upper Sand aquifer, and restrict unauthorized access to the contaminated areas of the Site. As a result, the Site's ***present state presents no unacceptable risk exposure***. Furthermore, unacceptable future risks associated with direct contact with surface soils and sediments are limited to a hypothetical child who is assumed to live onsite and trespass in the small Pond 2 Wet and l Seep 1 areas

Table 1. Summary of Comparison of Proposed Remedies

	Alternative 2	*Alternative 3a*
1. Overall Protection of Human Health and the Environment	✓	✓
2. Compliance with ARARs	✓	✓
3. Long-term Effectiveness and Permanence	This alternative relies on containment of the impacted soils and dewatering and treatment of the impacted ground water. There is less risk of unknowing exposure to residual contaminants. There is greater risk of failure of the containment but little potential consequence of a failure. In the event of a failure, cap repairs may be necessary and additional ground water extraction and treatment may be triggered under OU2.	Relies on ground water containment for duration of ground water enhanced biodegradation period. In the event of a failure of ground water containment, additional ground water extraction and treatment may be triggered under OU2. There is greater risk of unknowing exposure to residual contaminants.
4. Reduction of Toxicity, Mobility, or Volume Through Treatment	– Removes a significant mass of contaminants and all direct contact principal threat through excavation and off-site treatment. Continues removal of contaminants through ground water extraction and treatment.	+ Greater removal of contaminant mass. Removes both direct contact and ground water principal threat.
5. Short-Term Effectiveness	+ Minimal implementation risk. Immediate risk reduction and shorter timeframe to achieve remedial goals.	– Greater implementation risk to the community and workers. Longer timeframe to achieve remedial goals.
6. Implementability	+ Minimal implementability concerns. Monitoring is addressed through existing OU1 and OU2.	– Greater potential for schedule delays due to technical problems associated with deep excavation below the water table and occurrence of running sands, and due to potential constraints on rates of biodegradation of constituents in ground water.
7. Costs	+ $14 MM	– $23 MM
8. State Acceptance	+	+
9. Community Acceptance	+ *Incentives to provide enhancements to achieve* compatible future use acceptable to community.	– *Some greater duration and magnitude of nuisance to* community during remediation activities.

(see Environ's May 2000 Baseline Risk Assessment)). Excavation and offsite treatment of sediments from the Pond 2 Wet and Seep 1 areas, thereby eliminating these risks, are components of both Alternatives 2 and 3a. Thus, looking only at acceptable risk analysis, there is no basis to select Alternative 3a over 2 unless certain unlikely future activities were to occur that create exposure pathways.

Under OU2 the Settlors have implemented an ongoing onsite and offsite ground water monitoring program with a risk-based decision process that will provide treatment if determined to be necessary. EPA's Statutory Determinations for the OU2 Record of Decision state: "The selected remedy ***protects human health and the environment by controlling exposure to contaminated groundwater*** associated with the Site. This will provide a mechanism for controlling the migration of contaminants. . . . the onsite and offsite monitoring program, coupled with deferred onsite and/or offsite treatment, will be protective of human health and the environment." (emphasis added) The protections afforded by OU2 would apply to either Alternatives 2 or 3a.

Over several decades, Alternative 3a may restore the ground water quality in the Upper Sand while Alternative 2 restores the Upper Sand outside the boundary of the 18-acre containment area within a few years and "dewaters" the 18-acre containment area in less than a decade[1]. The Upper Sand is a perched aquifer, which occurs only in the "eastern excavation area" portion of the Site itself. It would not be a likely source of potable water. For instance, the upgradient background well, SMW-15, has naturally-occurring concentrations of nitrate slightly less than the MCL and manganese higher than the secondary MCL. Although it is much more likely that future development on the Site would be supported by County water, a future hypothetical onsite well would more likely be located in the Lower Sand and Bedrock aquifers even in the absence of contamination in the Upper Sand aquifer. In fact, current offsite wells are located in the Lower Sand and Bedrock aquifers.

3.0 REMEDY SELECTION CRITERIA

The National Contingency Plan (NCP 40 CFR Part 300) outlines the nine criteria to be considered by EPA in selecting remedial actions for Superfund Sites. Table 1 contains a summary chart of the nine criteria and comparison between Alternatives 2 and 3a. There are two threshold criteria which must be met for all remedial actions: protection of human health and the environment and compliance with applicable or relevant and appropriate requirements (ARARs). Both Alternative 2 and 3a meet these criteria. The remaining seven criteria must be balanced in selecting the remedial alternative. Following is a more detailed discussion of three of these criteria which the Settlors believe must be considered in the remedy selection process.

3.1 State and Community Acceptance

A major component of the analysis of the community and state acceptance of a remedy surrounds the current and future land uses for the Site. EPA's Directive on Land Use in the CERCLA Remedy Selection Process (OSWER Directive No. 9355.7-04) states that "particular focus on the community's desired future uses of property associated with the CERCLA site, should result in a more democratic decisionmaking process; greater community support for remedies selected as a result of this process; and more expedited, cost-effective cleanups." The Directive further states (see page 8) that "[i]n cases where the reasonably anticipated future land use is highly uncertain, a range of the reasonably likely future land uses should be considered in developing remedial action objectives. These likely future land uses can be reflected by developing a range of remedial alternatives that will achieve different land use potentials. The remedy selection process will determine which alternative is most appropriate for the site and, consequently, the land use(s)

[1] In an earlier draft version of the Focused Feasibility Study, a variation of Alternative 2 was presented but removed at EPA's direction. This alternative was similar to the present Alternative 2 without the impermeable cap over the contaminated area. By removing the Direct Contact Principal Threat material and not capping, natural flushing mechanisms and continued extraction and treatment of ground water protects human health and the environment while allowing ongoing natural degradation mechanisms to continue to remove residual soil contamination. A variation on this theme could accelerate restoration of ground water quality using an artificial wetlands-based re-infiltration ("accelerated flushing") strategy. This alternative would have costs similar to Alternative 2 and achieve the same ground water levels as Alternative 3a but over a longer time frame. Meanwhile, human and ecological receptors would be protected through a soil cap and deed notices providing access restrictions to the relatively small contaminated area until such a time as unrestricted standards were met.

available following remediation." Clearly it is the Directive's intent to select a remedy which balances the selection criteria to reach a cost-effective remedy in a reasonable timeframe that is consistent with the desires of the community.

The key to selecting an effective and cost-efficient remedy includes realistic consideration of future Site uses. To the extent that the landowner may derive economic benefit from future use of the property, we believe this must also be balanced with their liability as the owner and operator of the Site, as well as a nonparticipant in the Settling PRP Group.

The Maryland Sand, Gravel and Stone Site is made up of three parcels with a total land area of 153 acres. The Site, in its current condition, contains a diversity of habitats including ponds, wetlands, ephemerally wet zones, terrestrial grassland and deciduous woodlands. Much of the area disturbed during historical quarry activity is undergoing reforestation and revegetation through the natural succession process. The baseline ecological risk assessment indicated that ***ecological receptors are unlikely to be adversely affected by Site-related contaminants*** (except for the small Pond 2 Wet area which will be remediated under both Alternatives 2 and 3a.) Current conditions are favorable to the environment while future development could have a detrimental impact on the natural environment via loss of habitat.

The assumed land use that serves as the basis for EPA's remedy selection is residential development using shallow private wells to supply potable water. This section describes land use alternatives that would be desirable and likely to occur given the Site's land use attributes. These alternatives would be acceptable and beneficial to Cecil County and to the State of Maryland based on the County's and State's published land use and development goals and policies. The alternatives are: A) use of the Site for recreation; B) use of the Site for ecological open space; or C) use of the Site for development with connection to public water and sewer.

3.1 a) Site Planning Attributes

The Site is potentially valuable to the County and the State because of its strategic location near the center of Cecil County in the County's main development corridor. The Site is within the County's largest Development District and between the incorporated towns of Elkton and North East (see Figure 1, Cecil County Comprehensive Plan). Under the Comprehensive Plan, adopted in 1990 and amended in 1997, future growth is directed primarily to the Development, Town and Suburban Districts with the most intense development encouraged around Elkton, North East, Perryville and Port Deposit. Within the Development District, development of vacant land which is contiguous to existing development is to be encouraged by the provision of public water and sewer service (Plan p. 8).

US Route 40 runs through the Development District. The Route 40 corridor is the major business, employment and commercial corridor in the County. The Site enjoys direct access to this highway, as well as nearby access to Interstate 95. While the Site does not currently have access to public water or sewer, public water and sewer exists nearby both in the Towns of Elkton and North East, and the County's Water and Sewer Master Plan proposes extending public service along the entire Route 40 frontage (Figure 2).

Cecil County's Urban Growth Boundary Plan (2000) identifies three urban growth boundaries (UGBs) around Elkton one of which, UBG 3, includes the Site (see Figure 2). UGBs are areas the County considers suitable for growth and which the County desires to serve with public water and sewer. Reflecting the Route 40 Corridor's development value the State of Maryland recognizes Priority Funding Areas (PFAs) throughout the Route 40 Corridor including adjacent to the south and east of the Site. PFA's are areas considered suitable for growth under Maryland's SmartGrowth policies, and appropriate for state funding support. The County plans to use the Urban Growth Boundary Plan as the basis for updating its Water and Sewer Master Plan and its Comprehensive Plan, following which we would expect adjustments in the PFA boundaries to include the Site.

3.1 b) Land Use Options

A) Recreation

Because of size and central location, the Site is potentially valuable to the County for recreation purposes. Unlike many counties in Maryland, Cecil County does not have a major "countywide" park. Most of the parks in the County are small (less than 30 acres) or have small useable areas. The County's 1998 Land Preservation and Recreation Plan states that Cecil County is below the Maryland Program Open Space recommended goal of 30 acres recreation land per 1,000 persons, and will need to acquire approximately 750 acres of recreation and open space land by 2020 to meet the goal.

The Plan's demand analysis stated the need for additional athletic fields (baseball, soccer and football), swimming pools, nature trails and public water access.

There is interest in the county in a Countywide park that could include, for example, ball fields, courts, and trails. Although the County owns 164 acres at Chesland Park south of Elkton, this site was found unsuitable for a countywide park due to access and location issues. Because of its central location and access to main roads, the Site could meet this need as shown by Figure 3. A conceptual recreation plan assuming remedial Alternative 2 is shown in Figure 4.

B) Open Space

The Site is strategically located with respect to Maryland's green infrastructure in Cecil County. The Site has ecological value because it contains a diversity of habitats in a relatively small area including woodland, shallow wetlands, and ponds. The Green Infrastructure Initiative is a statewide effort by the Maryland Department of Natural Resources (DNR) to identify large, contiguous blocks of ecologically significant natural areas (hubs) and to link them with natural corridors to create an interconnected network of natural resource lands across the state. The State's Greenprint program is designed to begin protecting critical unprotected components of the green infrastructure.

Even with current conditions, prior to remediation, the Site's ecological population is thriving and the ecological risk assessment for the Site concluded that there was no risk to ecological receptors (except the small Pond 2 Wet areas that will be remediated under both Alternatives 2 and 3a). Over time, as reforestation and revegetation of the former quarry areas continues, ecological health will make further advances.

The Site is located between two identified large, contiguous blocks of ecologically significant natural areas (hubs), as shown on Figure 5. As a result, under Alternative 2, the Site could enhance Green Infrastructure in Cecil County as an expansion of the hub to the west (across Marley Road) and, possibly, as a hub or corridor connecting to the hub east of Nottingham Road.

C) Development

The Site would support future development but most likely with future County water and sewers. The Settlors believe that Cecil County wishes to promote economic development by developing its employment base and business tax base. Centrally located on the East Coast of the US, Cecil County is one of the few areas between New York and Washington with large amounts of developable industrial land. Although the County has several Enterprise Zones where industrial development is encouraged through state and local tax incentives, the County has few undeveloped tracts that are in the Route 40 corridor, are over 150 acres, and have easy access to I-95. A number of commercial and industrial land uses exist near the Site. Industrial use of the Site under Alternative 2 is a viable land use alternative that would be supported by County land use and economic development policy.

Much of the Site is zoned Development Residential (DR)[2] a zoning designation that includes agriculture, forestry, recreation and residential use among its permissible uses. The allowable residential density in the district increases from one dwelling unit per acre without public water/sewer up to four to six dwelling units per acre with public water/sewer. The DR district has a minimum 15 to 25 percent open space requirement. Development of the Site at higher residential density would be consistent with the Site's location in a Development District and with the County's planning for provision of future water and sewer. Residential development under this scenario would be feasible with either remedial Alternatives 2 and 3a. Alternative 3a is premised on the hypothetical low density residential use that is inconsistent with the Maryland and Cecil County's vision of efficient residential development as well as use of the shallow aquifer as drinking water. The Settlors do not support such future residential use of the eastern excavation area of this Site given that substantial alternative land is available within the area that would not be encumbered by real and perceived liability issues related to Superfund and related to the Site status as an inactive surface mine or quarry.

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[2] The Cecil County Zoning Ordinance specifically states "Development in this District should be concentrated and served by public water and sewer, if possible."

3.1 c) Institutional Controls

Based on the NCP, "EPA expects to use institutional controls such as water use and deed restrictions to supplement engineering controls as appropriate for short- and long-term management to prevent or limit exposure to hazardous substances, pollutants, or contaminants...... The use of institutional controls shall not substitute for active response measures.... as the ***sole remedy*** unless such active measures are determined not to be practicable, based on the balancing of trade-offs among alternatives that is conducted during the selection of remedy" (see 40 CFR 300.430(a)(1)iii(D)). Alternative 2 does not propose institutional controls as the ***sole remedy*** but rather as part of an alternative that removes and treats direct contact principal threat materials, contains other source materials, and treats ground water.

Institutional controls which are necessary to control remedial costs have not been fully considered by EPA Region III in their preferred Alternative 3a. The area where these controls are needed is limited to the approximate 18-acre capped area.

Because the long-term effectiveness of Alternative 2 relies on the actual future use of the Site there are opportunities for additional "enhancements." If there is substantial agreement on the future use of the Site, the implementation of the institutional controls and the design of the remedy can support and accommodate that future land use. As an example, of the more than 190 Superfund Sites remediated to date, approximately 50 are being used for recreational purposes, such as sports fields, hiking trails, parks, playgrounds, and picnic areas. Many of these sites rely on institutional controls.

3.2 Reduction Of Toxicity, Mobility Or Volume

Both Alternatives 2 and 3a treat the most highly contaminated soils remaining on the Site, although the alternatives differ in the extent of that treatment. The amount of material to be treated is defined by the term "principal threat", or the material which constitutes the primary threat at the Site. We believe the use of the term unfortunately conveys the impression of serious threat to human health that simply is not based on the realities of the Site. The Agency for Toxic Substances and Disease Registry in its 1994 Health Assessment for the Site concluded: "The Maryland Sand, Gravel, and Stone site currently poses no apparent public health hazard if implementation of the ROD continues."

We understand that EPA Region III favors Alternative 3a based on their interpretation that policies dictate[3] a 'preference for treatment' of principal threat materials. Principal threat materials at a Superfund site can be defined in a variety of ways. EPA uses many different methods to quantify principal threat volumes. For example, a qualitative description as hazardous waste is often used. Because the OU3 remedy focuses on the remaining soils contamination at the Site, and because OU1 and OU2 control any migration of contaminated groundwater, the EPA and the Settlors originally defined principal threat based on hypothetical future direct contact exposure to subsurface soils and Pond 2 Wet sediments. This is the "principal threat" material which is proposed for treatment in Alternative 2. However, EPA Region III subsequently proposed an alternative definition of principal threat soils, based upon assumed consumption of the Upper Sand ground water underlying the contaminated portion of the Site.

Principal threat treatment under OU3 should be considered in context with past remedial measures. EPA should take credit for a significant amount of past and ongoing treatment and removal of principal threat materials. Based on current exposure scenarios, the only unacceptable contaminated soils and sediments are located in a small pond ("Pond 2 Wet") and a very small area in the former Seep 1 area. Removal and offsite treatment of these materials are incorporated in both Alternative 2 and Alternative 3a. Almost all principal threat material, based on actual current and past exposure scenarios, already has been removed from the Site. In 1975, all the liquid waste from the original three disposal pits was

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[3]According to the Congressional Research Service (Report for Congress, Superfund Fact Book), EPA selected treatment at about 50 % of the sites with soil contamination. This is also supported by the EPA publication "Treatment Technologies for Site Cleanup Annual Status Report (Tenth Edition)" which for the last three years reported (1997 through 1999) slightly less than 50% of source control RODs specified "treatment." In other words, EPA appropriately is balancing all nine criteria in arriving at decisions concerning the need and extent of treatment.

removed from the Site under an order from the former Maryland Water Resources Administration. Approximately 1,200 buried drums were removed from Site and incinerated in 1990 as part of the OU1 remedy including approximately 200 tons of material. Surface discharges through seeps have been eliminated by the OU1 ground water extraction system.

In addition, a significant amount of ground water treatment has occurred as part of OU1 for the Site. Furthermore, continued ground water treatment is a major component of all proposed remedial alternatives in the FFS. Based on EPA Guidance, ground water treatment remedies may satisfy the statutory preference for treatment, even though contaminated ground water is not considered a principal threat waste and even though principal threat source material may not be treated (A Guide to Principal Threat and Low Level Threat Wastes (OSWER 9380.3-06FS, November 1991)).

As described in the Land Use Section, future residential, commercial or industrial development of the Site is not likely to occur without the availability of County water. Even if County water is not supplied to a future development at the Site, consumption of the shallow ground water is unlikely because more reliable and better quality sources exist in the Lower Sand and Bedrock aquifers. Under Alternative 2 ground water exposure would not occur within the capped area and would not be a "reasonably anticipated" future use.

OU2 provides ground water protection for the Middle Sand, Lower Sand and Bedrock aquifers.[4] Given that ground water treatment is in-place under OU1 for the Upper Sand ground water and available, if needed, under OU2 for offsite and other onsite aquifers, we believe the preference for treatment will be met by Alternative 2 by treatment of the direct contact principal threat material and past and ongoing treatment of ground water.

Even if the Ground Water Principal Threat definition is ultimately used for OU3, "[a]ddressing principal threat by treatment wherever practicable" should not be elevated to or conferred the same stature as a Threshold Criteria. The NCP sets forth six "expectations" including this one. "These expectations are not, however, binding requirements.... The fact that a proposed remedy may be consistent with the expectations does not constitute sufficient grounds for the selection of that alternative. All remedy selection decisions must be based on an analysis using the nine criteria." (See NCP Preamble March 8, 1990 page 8702). Alternative 2 provides the best balance of the nine criteria.

3.3 Cost

The incremental cost to pursue Alterative 3a over Alternative 2 is in excess of $9 million. Alternative 3a is premised on the assumption that future residential use and consumption of the Upper Sand ground water is the reasonable anticipated future land use. While residential use does remain a possibility for the Site, this development need not, and likely will not, include consumption of Upper Sand ground water. The more reasonable anticipated future land use for residential, industrial or commercial use would be with connections to County water. Furthermore, Alternative 2 does not eliminate the potential for development of the Site for these and other uses, but rather restricts only portions of the Site.

The landowner's agreement to deed restrict a limited area of his property could be considered his equitable share of the remediation expenses. With institutional controls as a supporting part of the Alternative 2, the landowner will not be shielded from paying any share of cleanup expenses while reserving the benefit of the remediated site for his own account. As the owner/operator responsible party who benefited economically from the disposal of wastes on his site, and who has not contributed to the remediation to date, the landowner should not be thus shielded from some equitable payment of response costs, even if not monetary in nature.

4.0 CONCLUSION:

The Settlors believe Alternative 2 would promote the productive reuse of the Site and meets EPA's overriding objective to ensure it is safe and that public or private use does not compromise or adversely affect the performance of the remedy. Alternative 2 is protective and achieves compliance with ARARs in a more cost effective manner.

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[4] Actual wells in the vicinity of the Site extract water from the Lower Sand and Bedrock aquifers rather than the Middle Sand aquifer.

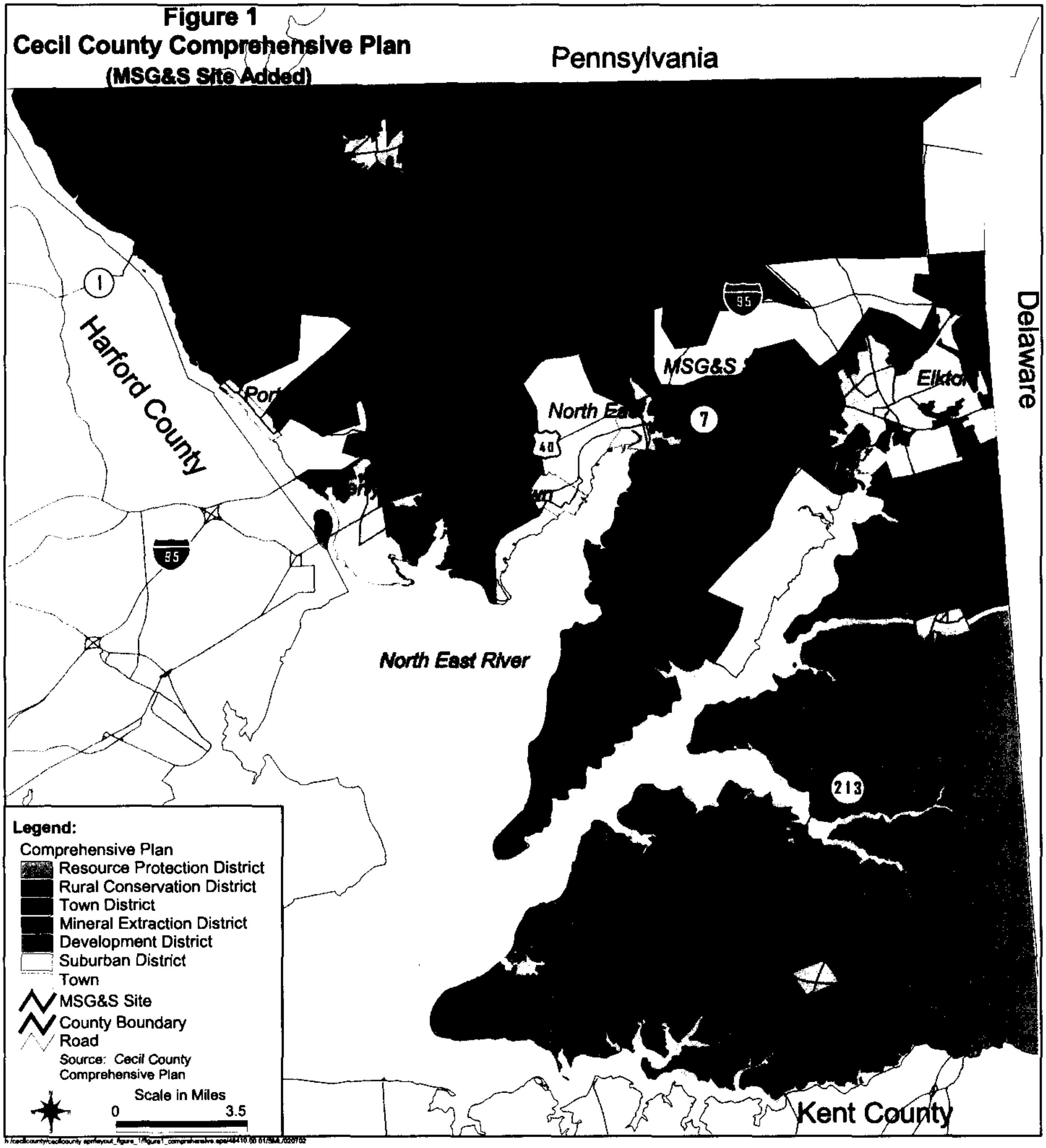
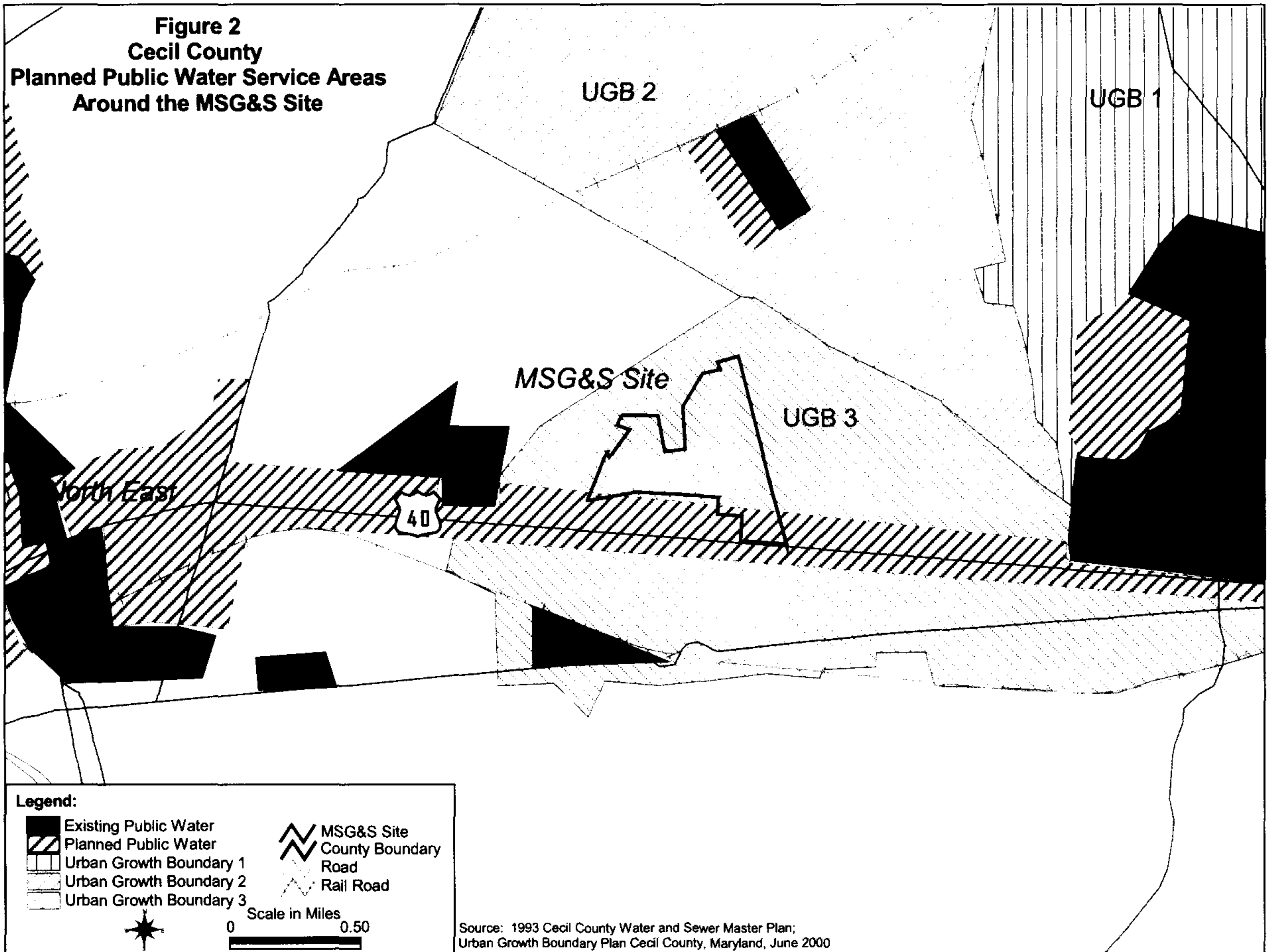


Figure 1
Cecil County Comprehensive Plan
(MSG&S Site Added)

Figure 2
Cecil County
Planned Public Water Service Areas
Around the MSG&S Site



Source: 1993 Cecil County Water and Sewer Master Plan;
Urban Growth Boundary Plan Cecil County, Maryland, June 2000

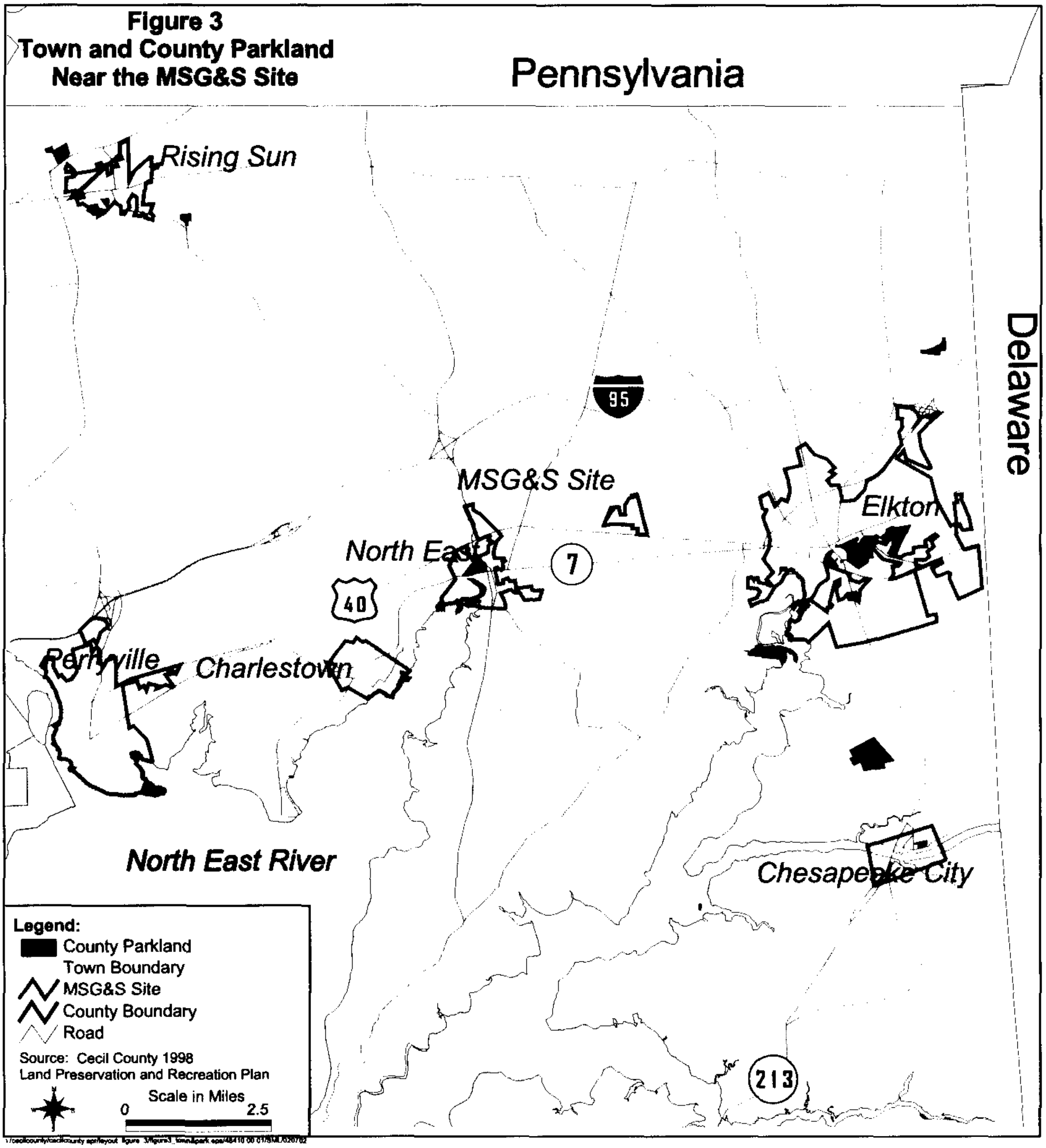


Figure 3
Town and County Parkland
Near the MSG&S Site
Pennsylvania
Delaware
Rising Sun
95
MSG&S Site
Elkton
North East
7
40
Perryville
Charlestown
North East River
Chesapeake City
213
Legend:
County Parkland
Town Boundary
MSG&S Site
County Boundary
Road
Source: Cecil County 1998
Land Preservation and Recreation Plan
Scale in Miles
0
2.5

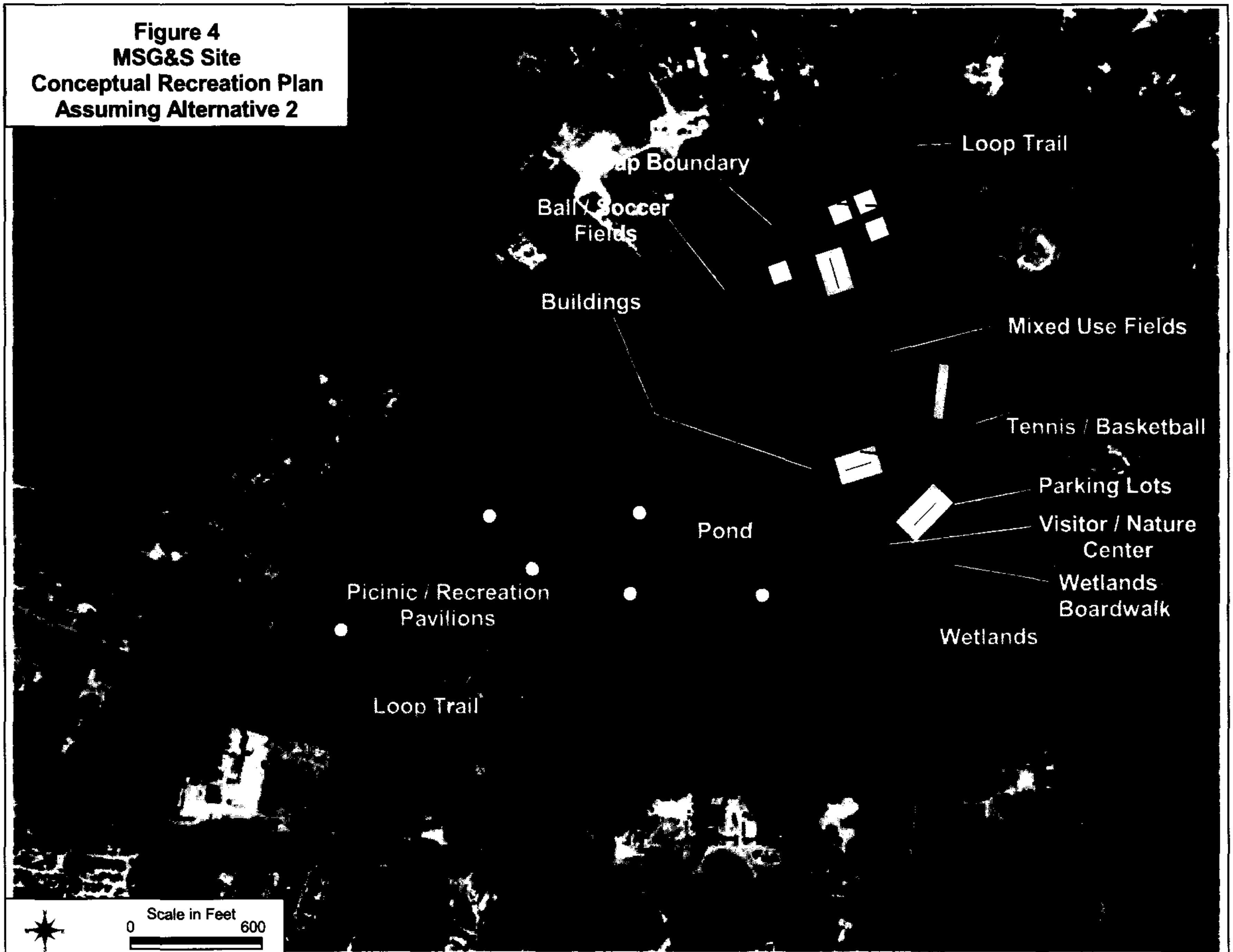


Figure 4
MSG&S Site
Conceptual Recreation Plan
Assuming Alternative 2
Loop Trail
p Boundary
Ball / Soccer
Fields
Buildings
Mixed Use Fields
Tennis / Basketball
Parking Lots
Visitor / Nature
Center
Pond
Wetlands
Boardwalk
Wetlands
Picinic / Recreation
Pavilions
Loop Trail
Scale in Feet
0
600

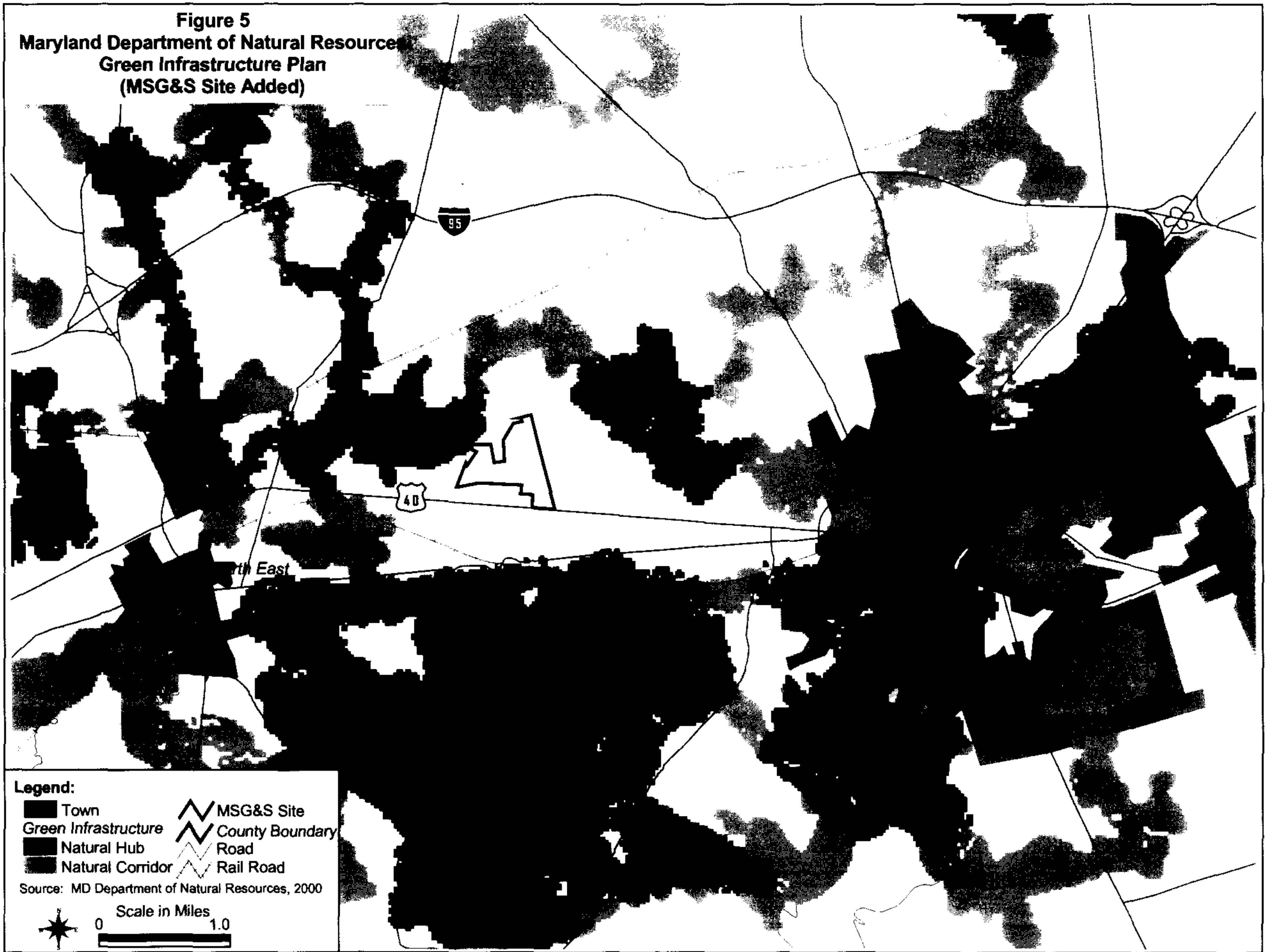


Figure 5
Maryland Department of Natural Resources
Green Infrastructure Plan
(MSG&S Site Added)
95
40
North East
Legend:
Town
Green Infrastructure
Natural Hub
Natural Corridor
MSG&S Site
County Boundary
Road
Rail Road
Source: MD Department of Natural Resources, 2000
Scale in Miles
0
1.0

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

SUBJECT: Additional Information for NRRB Briefing Package 4/9/02
Maryland Sand, Gravel and Stone Site

FROM: Debra Rossi, Remedial Project Manager

TO: All NRRB Members

Enclosed please find additional information requested during our 4/8/02 conference call:

- Detailed cost estimates (Alternatives 2 through 5)
- Risk Summary Tables from the *Baseline Risk Assessment* (BLRA) and the *Baseline Risk Assessment Addendum* (BLRA Addendum).

A note on the human health risk assessments:

The BLRA presents risk estimates for potential future onsite residents and industrial workers, as well as trespassing children. EPA required the PRPs to prepare the BLRA Addendum because the BLRA failed to consider the effects of exposure to subsurface soils which would likely be brought to the surface during the construction of homes or other facilities on the site. These documents do not consider exposure to contaminated ground water. However, soil screening levels for ground water protection were developed in the FS.

BLRA exposure scenarios:

- Future onsite maintenance workers, industrial workers and residents exposed to contaminated surface soils, air emissions from the existing air stripper, air emissions from soils (emissions rates determined from site flux chamber data)

- Offsite residents exposed to air emissions (from air stripper and site soils)

- "Site-wide" trespasser exposed to site surface soils (except Pond 2 "hot-spot"[1] surface soils) and air emissions (from air stripper and soils)

- "Pond 2" trespasser exposed to Pond 2 "hot-spot" surface soils, only, and air emissions (from air stripper and soils).

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[1]VOCs are the primary COCs at the site. However, a small volume (approx. 500 cu. yds.) of soil and sediment in the Pond 2 "hot-spot" is contaminated with pesticides, PCBs, metals.

BLRA Addendum exposure scenarios:

- Future onsite industrial workers and residents exposed to contaminants in the upper ten feet of soils (excluding Pond 2 "hot-spot" soil and sediment which was shown to present an unacceptable risk in the BLRA) and air emissions from the ground surface (emissions rates calculated using the Jury Model and the NAPL Model).

Table F-2

Alternative 2

Hot Spot Soil and Sediment Removal, Containment of Low-level Threat, and Expansion and Operation of the Ground Water Treatment System

Maryland Sand, Gravel and Stone Site

Elkton, Maryland

Item Description	Quantity	Unit	Unit Cost	Item Cost
Erosion & Sedimentation Controls	1	lump	$50,000	$50,000
Site Preparation/Clearing	18.0	acre	$6,000	$108,000
Site Fencing/Security	1	lump	$15,000	$15,000
				$173,000
Direct Contact Principal Threat [1]				
Excavation and Off-Site Disposal	500	cy	$850	$425,000
				$425,000
Backfill/Geosynthetic Cap/Restore Excavated Areas				
Backfill Treated Soil	*30,000*	cy	*$10*	*$300,000*
40 ml Geosynthetic cap	770,000	sf	$1.0	$770,000
Claymax	770,000	sf	$0.7	$539,000
Geocomposite Drain	770,000	sf	$0.7	$539,000
Cap Vent	770,000	sf	$0.3	$231,000
24" Vegetative Fill	58,000	cy	$14	$812,000
6" Topsoil	14,500	cy	$18	$261,000
Mulching/Seeding	85,556	sy	$1	$85,556
				$3,537,556
Vertical Barrier Wall -Full Site				
Mobilization/Set-up	1	lump	$50,000	$50,000
Installation (1300 lf. x 2 ft. wide x 25 ft. deep)	32,500	sf	$16	$520,000
Handling/Grading of Trench Spoils	7,500	cy	$8	$133,600
				$703,600
Extend Groundwater Recovery Trench				
Trench Excavation (20' deep)	300	feet	$400	$120,000
Spoils Treatment	600	ton	$100	$60,000
Trench Backfilling/Restoration	400	cy	$50	$10,000
Piping, Sump, Pump, Controls	1	lump	$30,000	$30,000
				$220,000
Direct Construction Total (DCT)				$5,059,156
Constuction Total				$5,059,200
Performance Test				$100,000
Remedial Design, Construction Oversight, & Project Management (19%) [2]				$961,240
Subtotal Construction Cost				$6,120,400
Contingency (25%)				$1,530,100
Total Capital Cost				$7,651,000
Total Present Worth O&M Cost				$6,652,000
Projected Opinion of Probable Cost [3]				**$14,300,000**

O&M Costs
Alternative 2
Hot Spot Soil and Sediment Removal, Containment of Low-level Threat, and Expansion and Operation of the Ground Water Treatment System

Description	Unit Cost	Present Worth [4]
O&M for Cap / Dewatering System (Year 1-30)	$60,000	$745,000
O&M for Exist. GW System (Year 1-5)	$350,000	$1,435,000
O&M for Red. GW System (Year 5 10)	$200,000	$585,000
O&M for Red. GW System (Year 10 30)	$100,000	$539,000
O&M for Site Security (1st Phase Year 1-5)	$130,000	$533,000
O&M for Site Security (2nd Phase - Year 5 30)	$30,000	$249,000
Upper Sands GW Monitoring (1st Phase - Year 1-10)	$60,000	$421,000
Upper Sands GW Monitoring (2nd Phase - Year 10-30)	$30,000	$162,000
Middle Sands GW Monitoring (1st Phase - Year 1 10)	$60,000	$421,000
Middle Sands GW Monitoring (2nd Phase Year 10-30)	$30,000	$162,000
EPA 5 Year Review (Year 5, 10, 15, 20, 25, 30)	$25,000	$69,600
Subtotal:		$5,321,600
25% Contingency		$1,330,400
Projected Opinion of Probable O&M Cost		$6,652,000

Notes:

1) Direct Contact Principal Threat Material includes material in Pond 2 wet and NDA identified in the BRA and BLRAA as direct contact Principal Threat.
2) Project Management (5%); Remedial Design (8%); Construction Management (6%) of DCT. (EPA 540 R 00 002, July 2000)
3) Estimated costs are based on conceptual evaluation of the potential alternative, and are subject to change based on future investigations and evaluations.
4) A discount rate of 7% after inflation was assumed for the present worth analysis. (EPA 540-R-00-002, July 2000)

Table F-3a

Alternative 3a

Ex-Situ Treatment of Ground Water Principal Threat Soil (by LTTD), Enhanced Biodegradation of Low-Level Threat Soil, and Expansion and Operation of the Ground Water Treatment System

Maryland Sand, Gravel and Stone Site

Elkton, Maryland

Item Description	*Quantity*	*Unit*	*Unit Cost*	*Item Cost*
Erosion & Sedimentation Controls	1	lump	$30,000	$30,000
Site Preparation/Clearing	3.0	acre	$6,000	$18,000
Site Fencing/Security	1	lump	$15,000	$15,000
Special Material Excavation and Off-Site Disposal [(1)]	1,000	cy	$850	$850,000
				$913,000
Excavation/On-Site Thermal Desorption of Principal Threat				
LTTD Mobilization/Demobilization	1	lump	$500,000	$500,000
Enclosure Structure (incl. set-up @ 3 locations)	1	lump	$450,000	$450,000
Air Handling System	1	lump	$60,000	$60,000
VOC Emission Control Unit (ThermOx)	1	lump	$100,000	$100,000
Sheeting/Shoring for Ex. Below GWT	22,500	sf	$12	$270,000
Excavation Dewatering/Treat Water On-Site	1	lump	$25,000	$25,000
Soil Excavation/Processing	30,000	cy	$20	$600,000
Dewatering/Drying of Saturated Soils	7,000	cy	$16	$112,000
Post-Excavation Sampling/Analysis	1	lump	$30,000	$30,000
On-Site HTTD Treatment	3900	ton	$150	$585,000
On-Site LTTD Treatment	41,100	ton	$100	$4,110,000
Disposal of Desorbed/Condensed Residuals	1	lump	$100,000	$100,000
				$6,942,000
Backfill/Restore Excavated Areas				
Backfill Treated Soil	30,000	cy	$10	$300,000
6" Topsoil	1,200	cy	$18	$21,600
Mulching/Seeding	7,111	sy	$1.00	$7,111
				$328,711
Extend Groundwater Recovery Trench				
Trench Excavation (20' deep)	300	feet	$400	$120,000
Spoils Treatment	600	ton	$100	$60,000
Trench Backfilling/Restoration	400	cy	$50	$20,000
Piping, Sump, Pump, Controls	1	lump	$30,000	$30,000
				$230,000
Enhanced Bioremediation				
Substrate Injections (25 ft. centers) [(2)]	927	boring	$500	$463,500
Substrate Cost	102,000	gal	$3	$306,000
				$769,500
Direct Construction Total (DCT)				$9,183,200

Constuction Total	$9,183,200
Performance Test (Low Temperature Thermal Desorption)	$100,000
Performance Test (High Temperature Thermal Desorption)	$150,000
Remedial Design, Construction Oversight, & Project Management (19%) [3]	$1,744,808
Subtotal Construction Cost	$11,178,000
Contingency (35%)	$3,912,300
Total Capital Cost	$15,090,000
Total Present Worth O&M Cost	$8,394,500
Projected Opinion of Probable Cost [4]	**$23,480,000**

O&M Costs

Alternative 3a

Ex-Situ Treatment of Ground Water Principal Threat Soil (by LTTD), Enhanced Biodegradation of Low-Level Threat Soil, and Expansion and Operation of the Ground Water Treatment System

Description	**Unit Cost**	**Present Worth** [5]
O&M/Sampling of Treatment Activities (Year 1-10)	$25,000	$193,000
O&M for Exist. GW System (Year 1-30)	$350,000	$4,343,000
O&M for Site Security (1st Phase - Year 1-5)	$130,000	$533,000
O&M for Site Security (2nd Phase - Year 5-30)	$30,000	$249,000
Upper Sands GW Monitoring (Year 1-30)	$60,000	$745,000
Middle Sands GW Monitoring (1st Phase - Year 1-10)	$60,000	$421,000
Middle Sands GW Monitoring (2nd Phase - Year 10-30)	$30,000	$162,000
EPA 5-Year Review (Year 5, 10, 15, 20, 25, 30)	$25,000	$69,600
Subtotal:		$6,715,600
25% Contingency		$1,678,900
Projected Opinion of Probable O&M Cost		$8,394,500

Notes:

1) Special Material includes material not amenable to treatment by the selected technology, including sediment from Pond 2 wet containing metals, pesticides, and PCBs;and rubbery, stringy material encountered in NDA.
2) 50% of area will be subject to retreatment.
3) Project Management (5%); Remedial Design (8%); Construction Management (6%) of DCT (EPA 540-R-00-002, July 2000)
4) Estimated costs are based on conceptual evaluation of the potential alternative, and are subject to change based on future investigations and evaluations.
5) A discount rate of 7% after inflation was assumed for the present worth analysis. (EPA 540-R-00-002, July 2000)

Table F-3a

Alternative 3a (Without Enclosure)

Ex-Situ Treatment of Ground Water Principal Threat Soil (by LTTD), Enhanced Biodegradation of Low-Level Threat Soil, and Expansion and Operation of the Ground Water Treatment System

Maryland Sand, Gravel and Stone Site

Elkton, Maryland

Item Description	Quantity	Unit	Unit Cost	Item Cost
Erosion & Sedimentation Controls	1	lump	$30,000	$30,000
Site Preparation/Clearing	3.0	acre	$6,000	$18,000
Site Fencing/Security	1	lump	$15,000	$15,000
Special Material Excavation and Off-Site Disposal [1]	1,000	cy	$850	$850,000
				$913,000
Excavation/On-Site Thermal Desorption of Principal Threat				
LTTD Mobilization/Demobilization	1	lump	$500,000	$500,000
Real -time Air Monitoring during excavation	1,000	hour	$100	$100,000
VOC/Dust Suppression Equipment	1	lump	$25,000	$25,000
Sheeting/Shoring for Ex. Below GWT	22,500	sf	$12	$270,000
Excavation Dewatering/Treat Water On-Site	1	lump	$25,000	$25,000
Soil Excavation/Processing	30,000	cy	$12	$360,000
Dewatering/Drying of Saturated Soils	7,000	cy	$16	$112,000
Post-Excavation Sampling/Analysis	1	lump	$30,000	$30,000
On-Site HTTD Treatment	3900	ton	$150	$585,000
On-Site LTTD Treatment	41,100	ton	$100	$4,110,000
Disposal of Desorbed/Condensed Residuals	1	lump	$100,000	$100,000
				$6,217,000
Backfill/Restore Excavated Areas				
Backfill Treated Soil	30,000	cy	$10	$300,000
6" Topsoil	1,200	cy	$18	$21,600
Mulching/Seeding	7,111	sy	$1.00	$7,111
				$328,711
Extend Groundwater Recovery Trench				
Trench Excavation (20' deep)	300	feet	$400	$120,000
Spoils Treatment	600	ton	$100	$60,000
Trench Backfilling/Restoration	400	cy	$50	$20,000
Piping, Sump, Pump, Controls	1	lump	$30,000	$30,000
				$230,000
Enhanced Bioremediation				
Substrate Injections (25 ft. centers) [2]	927	boring	$500	$463,500
Substrate Cost	102,000	gal	$3	$306,000
				$769,500
Direct Construction Total (DCT)				$8,458,200

Constuction Total	$8,458,200
Performance Test (Low Temperature Thermal Desorption)	$100,000
Performance Test (High Temperature Thermal Desorption)	$150,000
Remedial Design, Construction Oversight, & Project Management (19%) [3]	$1,607,058
Subtotal Construction Cost	$10,315,300
Contingency (35%)	$3,610,355
Total Capital Cost	$13,926,000
Total Present Worth O&M Cost	$8,394,500
Projected Opinion of Probable Cost [4]	**$22,320,000**

O&M Costs

Alternative 3a

Ex-Situ Treatment of Ground Water Principal Threat Soil (by LTTD), Enhanced Biodegradation of Low-Level Threat Soil, and Expansion and Operation of the Ground Water Treatment System

Description	Unit Cost	Present Worth [5]
O&M/Sampling of Treatment Activities (Year 1-10)	$25,000	$193,000
O&M for Exist. GW System (Year 1-30)	$350,000	$4,343,000
O&M for Site Security (1st Phase - Year 1-5)	$130,000	$533,000
O&M for Site Security (2nd Phase - Year 5-30)	*$30,000*	*$249,000*
Upper Sands GW Monitoring (Year 1-30)	$60,000	$745,000
Middle Sands GW Monitoring (1st Phase - Year 1-10)	$60,000	$421,000
Middle Sands GW Monitoring (2nd Phase - Year 10-30)	$30,000	$162,000
EPA 5-Year Review (Year 5, 10, 15, 20, 25, 30)	$25,000	$69,600
Subtotal:		$6,715,600
25% Contingency		*$1,678,900*
Projected Opinion of Probable O&M Cost		$8,394,500

Notes:

1) Special Material includes material not amenable to treatment by the selected technology, including sediment *from Pond 2 wet containing metals, pesticides, and PCBs;and rubbery, stringy material encountered in NDA.*
2) 50% of area will be subject to retreatment.
3) Project Management (5%); Remedial Design (8%); Construction Management (6%) of DCT (EPA 540-R-00-002, July 2000)
4) Estimated costs are based on conceptual evaluation of the potential alternative, and are subject to change based on future investigations and evaluations.
5) A discount rate of 7% after inflation was assumed for the present worth analysis. (EPA 540-R-00-002, July 2000)

Table F-3b

Alternative 3b

In-Situ Treatment of Ground Water Principal Threat Soil, Enhanced Bioremediation of Low-Level Threat Soil, and Expansion and Operation of the Ground Water Treatment System

Maryland Sand, Gravel and Stone Site

Elkton, Maryland

Item Description	Quantity	Unit	Unit Cost	Item Cost
Erosion & Sedimentation Controls	1	lump	$20,000	$20,000
Site Preparation/Clearing	3	acre	$6,000	$18,000
Site Fencing/Security	1	lump	$15,000	$15,000
Special Material Excavation and Off Site Disposal [1]	1,000	cy	$850	$850,000
				$903,000
In-Situ Treatment of Principal Threat				
Mobilization/Setup of SPH [2]	1	lump	$200,000	$200,000
In Situ Thermal Treatment	30,000	cy	$200	$6,000,000
Vapor Emission Controls	1	lump	$450,000	$450,000
Sampling/Monitoring	1	lump	$80,000	$80,000
				$6,730,000
Restore Treated Areas				
24" Topsoil	4,800	cy	$18	$86,400
Mulching/Seeding	7,111	sy	$1.00	$7,111
				$93,511
Extend Groundwater Recovery Trench				
Trench Excavation (20' deep)	300	feet	$400	$120,000
Spoils Transportation/Disposal	400	cy	$500	$200,000
Trench Backfilling/Restoration	400	cy	$50	$20,000
Piping, Sump, Pump, Controls	1	lump	$30,000	$30,000
				$370,000
Enhanced Bioremediation				
Substrate Injections (25 foot centers) [3]	927	boring	$500	$463,500
Substrate Cost	102,000	gallon	$3	$306,000
				$769,500
Direct Construction Total (DCT)				$8,866,000
Construction Total				$8,866,000
Treatability Studies/Pilot Studies				$200,000
Remedial Design, Construction Oversight, & Project Management (19%) [4]				$1,684,540
Subtotal Construction Cost				$10,751,000
Contingency (30%)				$3,225,300
Total Capital Cost				$13,976,300
Total Present Worth O&M Cost (from below)				$8,394,500
Projected Opinion of Probable Cost [5]				**$22,370,000**

O&M Costs

Alternative 3b

In-Situ Treatment of Ground Water Principal Threat Soil, Enhanced Bioremediation of Low-Level Threat Soil, and Expansion and Operation of the Ground Water Treatment System

Description	**Unit Cost**	**Present Worth[6]**
O&M/Sampling of Treatment Activities (Year 1-10)	$25,000	$193,000
O&M for Exist. GW System (Year 1-30)	$350,000	$4,343,000
O&M for Site Security (Year 1-5)	$130,000	$533,000
O&M for Site Security (Year 5-30)	$30,000	$249,000
Upper Sands GW Monitoring (Year 1-30)	$60,000	$745,000
Middle Sands GW Monitoring (1st Phase Year 1-10)	$60,000	$421,000
Middle Sands GW Monitoring (2nd Phase - Year 10-30)	$30,000	$162,000
EPA 5 Year Review (Year 5, 10, 15, 20, 25, 30)	$25,000	$69,600
Subtotal:		$6,715,600
25% Contingency		$1,678,900
Projected Opinion of Probable O&M Cost		$8,394,500

Notes:

1) Special Material includes material not amenable to treatment by the selected technology, including sediment from Pond 2 wet containing metals, pesticides, and PCBs;and rubbery, stringy material encountered in NDA.
2) In-situ thermal remediation costs based on use of six-phase resistive heating (SPH). Based on supplemental investigations, other thermal technologies such as steam stripping, may be considered.
3) 50% of area will be subject to retreatment
4) Project Management (5%); Remedial Design (8%); Construction Management (6%) of DCT. (EPA 540-R-00-002, July 2000)
5) Estimated costs are based on conceptual evaluation of the potential alternative, and are subject to change based on future investigations and evaluations.
6) A discount rate of 7% after inflation was assumed for the present worth analysis. (EPA 540-R-00-002, July 2, 2000)

Table F-3c

Alternative 3c

Ex-Situ Treatment of Ground Water Principal Threat Soil above the Water Table, In-Situ Treatment of Ground Water Principal Threat Soil Below the Water Table Via Chemical Oxidation, Enhanced Biodegradation of Low-Level Threat Soil, and Expansion and Operation of the Ground Water Treatment System.

Maryland Sand, Gravel and Stone Site

Elkton, Maryland

Item Description	Quantity	Unit	Unit Cost	Item Cost
Erosion & Sedimentation Controls	1	lump	$30,000	$30,000
Site Preparation/Clearing	3.0	acre	$6,000	$18,000
Site Fencing/Security	1	lump	$15,000	$15,000
Special Material Excavation and Off-Site Disposal [1]	1,000	cy	$850	$850,000
				$913,000
Excavation/On-Site Thermal Desorption of Principal Threat above water table				
LTTD Mobilization/Demobilization	1	lump	$500,000	$500,000
Enclosure Structure (incl. set-up @ 3 locations)	1	lump	$450,000	$450,000
Air Handling System	1	lump	$60,000	$60,000
VOC Emission Control Unit (ThermOx)	1	lump	$100,000	$100,000
Soil Excavation/Processing	23,000	cy	$20	$460,000
Post-Excavation Sampling/Analysis	1	lump	$30,000	$30,000
On-Site Treatment	34,500	ton	$100	$3,450,000
Disposal of Desorbed/Condensed Residuals	1	lump	$100,000	$100,000
				$5,150,000
In-situ Chemical Oxidation of Pricipal Threat below water table				
Mobilization/Setup of Injection Equipment	1	lump	$100,000	$100,000
In Situ Injection of Oxidant [2] [3]	15,000	cy	$20	$300,000
Permanganate Cost	38	ton	$3,000	$114,000
Persulfate Cost	75	ton	$2,500	$187,500
				$701,500
Backfill/Restore Excavated Areas				
Backfill Treated Soil	30,000	cy	$10	$300,000
6" Topsoil	1,200	cy	$18	$21,600
Mulching/Seeding	7,111	sy	$1.00	$7,111
				$328,711
Extend Groundwater Recovery Trench				
Trench Excavation (20' deep)	300	feet	$400	$120,000
Spoils Treatment	600	ton	$100	$60,000
Trench Backfilling/Restoration	400	cy	$50	$20,000
Piping, Sump, Pump, Controls	1	lump	$30,000	$30,000
				$230,000
Enhanced Bioremediation				
Substrate Injections (25 ft. centers) [3]	927	boring	$500	$463,500
Substrate Costs	102,000	gal.	$3	$306,000
				$769,500
Direct Construction Total (DCT)				$8,092,700

Constuction Total	$8,092,700
Performance Test (Low Temperature Thermal Desorption)	$100,000
Performance Test (High Temperature Thermal Desorption)	$150,000
Remedial Design, Construction Oversight, & Project Management (19%) [4]	$1,537,613
Subtotal Construction Cost	$9,880,300
Contingency (30%)	$2,964,090
Total Capital Cost	$12,844,000
Total Present Worth O&M Cost	$8,394,500
Projected Opinion of Probable Cost [5]	**$21,240,000**

O&M Costs
Alternative 3c
Ex-Situ Treatment of Ground Water Principal Threat Soil above the Water Table, In-Situ Treatment of Ground Water Principal Threat Soil Below the Water Table Via Chemical Oxidation, Enhanced Biodegradation of Low-Level Threat Soil, and Expansion and Operation of the Ground Water Treatment System.

Description	Unit Cost	Present Worth [6]
O&M/Sampling of Treatment Activities (Year 1-10)	$25,000	$193,000
O&M for Exist. GW System (Year 1-30)	$350,000	$4,343,000
O&M for Site Security (1st Phase Year 1-5)	$130,000	$533,000
O&M for Site Security (2nd Phase - Year 5-30)	$30,000	$249,000
Upper Sands GW Monitoring (Year 1-30)	$60,000	$745,000
Middle Sands GW Monitoring (1st Phase - Year 1-10)	$60,000	$421,000
Middle Sands GW Monitoring (2nd Phase - Year 10-30)	$30,000	$162,000
EPA 5-Year Review (Year 5, 10, 15, 20, 25, 30)	$25,000	$69,600
Subtotal:		$6,715,600
25% Contingency		$1,678,900
Projected Opinion of Probable O&M Cost		$8,394,500

Notes:

1) Special Material includes material not amenable to treatment by the selected technology, including sediment from Pond 2 wet containing metals, pesticides, and PCBs;and rubbery, stringy material encountered in NDA.
2) Below water table oxidant solution to be injected rather than mixed.
3) 50% of area will be subject to retreatment
4) Project Management (5%); Remedial Design (8%); Construction Management (6%) of DCT. (EPA 540-R-00-002, July 2000)
5) Estimated costs are based on conceptual evaluation of the potential alternative, and are subject to change based on future investigations and evaluations.
6) A discount rate of 7% after inflation was assumed for the present worth analysis. (EPA 540-R-00-002, July 2000)

Table F-3c
Alternative 3c (Without Enclosure)
Ex-Situ Treatment of Ground Water Principal Threat Soil above the Water Table,
In-Situ Treatment of Ground Water Principal Threat Soil Below the Water Table
Via Chemical Oxidation, Enhanced Biodegradation of Low-Level Threat Soil,
and Expansion and Operation of the Ground Water Treatment System.
Maryland Sand, Gravel and Stone Site
Elkton, Maryland

Item Description	Quantity	Unit	Unit Cost	Item Cost
Erosion & Sedimentation Controls	1	lump	$30,000	$30,000
Site Preparation/Clearing	3.0	acre	$6,000	$18,000
Site Fencing/Security	1	lump	$15,000	$15,000
Special Material Excavation and Off-Site Disposal [1]	1,000	cy	$850	$850,000
				$913,000
Excavation/On-Site Thermal Desorption of Principal Threat above water table				
LTTD Mobilization/Demobilization	1	lump	$500,000	$500,000
Real-time Air Monitoring during excavation	767	hour	$100	$76,667
VOC/Dust Suppression Equipment	1	lump	$25,000	$25,000
Soil Excavation/Processing	23,000	cy	$12	$276,000
Post-Excavation Sampling/Analysis	1	lump	$30,000	$30,000
On-Site Treatment	34,500	ton	$100	$3,450,000
Disposal of Desorbed/Condensed Residuals	1	lump	$100,000	$100,000
				$4,457,667
In-situ Chemical Oxidation of Pricipal Threat below water table				
Mobilization/Setup of Injection Equipment	1	lump	$100,000	$100,000
In-Situ Injection of Oxidant [2] [3]	15,000	cy	$20	$300,000
Permanganate Cost	38	ton	$3,000	$114,000
Persulfate Cost	75	*ton*	$2,500	$187,500
				$701,500
Backfill/Restore Excavated Areas				
Backfill Treated Soil	30,000	cy	$10	$300,000
6" Topsoil	1,200	cy	$18	$21,600
Mulching/Seeding	7,111	sy	$1.00	$7,111
				$328,711
Extend Groundwater Recovery Trench				
Trench Excavation (20' deep)	300	feet	$400	$120,000
Spoils Treatment	600	ton	$100	$60,000
Trench Backfilling/Restoration	400	cy	$50	$20,000
Piping, Sump, Pump, Controls	1	lump	$30,000	$30,000
				$230,000
Enhanced Bioremediation				
Substrate Injections (25 ft. centers) [3]	927	boring	$500	$463,500
Substrate Costs	102,000	gal.	$3	$306,000
				$769,500
Direct Construction Total (DCT)				$7,400,400

Constuction Total	$7,400,400
Performance Test (Low Temperature Thermal Desorption)	$100,000
Performance Test (High Temperature Thermal Desorption)	$150,000
Remedial Design, Construction Oversight, & Project Management (19%) [4]	$1,406,076
Subtotal Construction Cost	$9,056,500
Contingency (30%)	$2,716,950
Total Capital Cost	$11,773,000
Total Present Worth O&M Cost	$8,394,500
Projected Opinion of Probable Cost [5]	**$20,170,000**

O&M Costs
Alternative 3c
Ex-Situ Treatment of Ground Water Principal Threat Soil above the Water Table, In-Situ Treatment of Ground Water Principal Threat Soil Below the Water Table Via Chemical Oxidation, Enhanced Biodegradation of Low-Level Threat Soil, and Expansion and Operation of the Ground Water Treatment System.

Description	**Unit Cost**	**Present Worth [6]**
O&M/Sampling of Treatment Activities (Year 1-10)	$25,000	$193,000
O&M for Exist. GW System (Year 1-30)	$350,000	$4,343,000
O&M for Site Security (1st Phase Year 1-5)	$130,000	$533,000
O&M for Site Security (2nd Phase - Year 5-30)	$30,000	$249,000
Upper Sands GW Monitoring (Year 1-30)	$60,000	$745,000
Middle Sands GW Monitoring (1st Phase - Year 1-10)	$60,000	$421,000
Middle Sands GW Monitoring (2nd Phase - Year 10-30)	$30,000	$162,000
EPA 5-Year Review (Year 5, 10, 15, 20, 25, 30)	$25,000	$69,600
Subtotal:		$6,715,600
25% Contingency		$1,678,900
Projected Opinion of Probable O&M Cost		$8,394,500

Notes:

1) Special Material includes material not amenable to treatment by the selected technology, including sediment from Pond 2 wet containing metals, pesticides, and PCBs;and rubbery, stringy material encountered in NDA.
2) Below water table oxidant solution to be injected rather than mixed.
3) 50% of area will be subject to retreatment
4) Project Management (5%); Remedial Design (8%); Construction Management (6%) of DCT. (EPA 540-R-00-002, July 2000)
5) Estimated costs are based on conceptual evaluation of the potential alternative, and are subject to change based on future investigations and evaluations.
6) A discount rate of 7% after inflation was assumed for the present worth analysis. (EPA 540-R-00-002, July 2000)

Table F-4a

Alternative 4a

Ex-Situ Treatment of Ground Water Principal Threat Soil, Low-level Threat Area Low-Permeability Cap and Barrier Wall, and Expansion and Operation of the Ground Water Treatment System

Maryland Sand, Gravel and Stone Site

Elkton, Maryland

Item Description	Quantity	Unit	Unit Cost	Item Cost
Erosion & Sedimentation Controls	1	lump	$50,000	$50,000
Site Preparation/Clearing	18.0	acre	$6,000	$108,000
Site Fencing/Security	1	lump	$15,000	$15,000
Special Material Excavation and Off Site Disposal [1]	1,000	cy	$850	$850,000
				$1,023,000
Excavation of Principal Threat w/On-Site Thermal Desorption to SSL-based risk				
LTTD Mobilization/Demobilization	1	lump	$500,000	$500,000
Enclosure Structure (incl. set-up @ 3 locations)	1	lump	$450,000	$450,000
Air Handling System	1	lump	$60,000	$60,000
VOC Emission Control Unit (ThermOx)	1	lump	$100,000	$100,000
Sheeting/Shoring for Ex. Below GWT	22,500	sf	$12	$270,000
Excavation Dewatering/Treat Water On Site	1	lump	$25,000	$25,000
Soil Excavation/Processing	30,000	cy	$20	$600,000
Dewatering/Drying of Saturated Soils	7,000	cy	$16	$112,000
Post-Excavation Sampling/Analysis	1	lump	$30,000	$30,000
On-Site Treatment	45,000	ton	$100	$4,500,000
Disposal of Desorbed/Condensed Residuals	1	lump	$100,000	$100,000
				$6,747,000
Backfill/Geosythetic Cap/Restore Excavated Areas				
Backfill Treated Soil	30,000	cy	$10	$300,000
40 ml Geosynthetic cap	770,000	sf	$1	$770,000
Claymax	770,000	sf	$0.7	$539,000
Geocomposite Drain	770,000	sf	$0.7	$539,000
Cap Vent	770,000	sf	$0.3	$231,000
24" Vegetative Fill	58,000	cy	$14	$812,000
6" Topsoil	14,500	cy	$18	$261,000
Mulching/Seeding	85,556	sy	$1.00	$85,556
				$3,537,556
Vertical Barrier Wall -Full Site				
Mobilization/Set-up	1	lump	$50,000	$50,000
Installation (1300 lf. x 2 ft. wide x 25 ft. deep)	32,500	cf	$16	$520,000
Handling/Grading of Trench Spoils	7,500	cy	$8	$133,600
				$703,600
Extend Groundwater Recovery Trench				
Trench Excavation (20' deep)	300	feet	$400	$120,000
Spoils Treatment	600	ton	$100	$60,000
Trench Backfilling/Restoration	400	cy	$50	$10,000
Piping, Sump, Pump, Controls	1	lump	$30,000	$30,000
				$220,000
Direct Construction Total (DCT)				$12,231,200

Constuction Total	$12,231,200
Performance Test (Low Temperature Thermal Desorption)	$100,000
Remedial Design, Construction Oversight, & Project Management (19%) [2]	$2,323,928
Subtotal Construction Cost	$14,655,100
Contingency (35%)	$5,129,285
Total Capital Cost	$19,784,000
Total Present Worth O&M Cost	$6,652,000
Projected Opinion of Probable Cost [3]	**$26,440,000**

O&M Costs
Alternative 4a
Ex-Situ Treatment of Ground Water Principal Threat Soil, Low-level Threat Area Low-Permeability Cap and Barrier Wall, and Expansion and Operation of the Ground Water Treatment System

Description	**Unit Cost**	**Present Worth [4]**
O&M for Cap / Dewatering System (Year 1-30)	$60,000	$745,000
O&M for Exist. GW System (Year 1-5)	$350,000	$1,435,000
O&M for Red. GW System (Year 5-10)	$200,000	$585,000
O&M for Red. GW System (Year 10-30)	$100,000	$539,000
O&M for Site Security (1st Phase - Year 1-5)	$130,000	$533,000
O&M for Site Security (2nd Phase - Year 5-30)	$30,000	$249,000
Upper Sands GW Monitoring (1st Phase - Year 1-10)	$60,000	$421,000
Upper Sands GW Monitoring (2nd Phase - Year 10-30)	$30,000	$162,000
Middle Sands GW Monitoring (1st Phase - Year 1-10)	$60,000	$421,000
Middle Sands GW Monitoring (2nd Phase - Year 10-30)	$30,000	$162,000
EPA 5-Year Review (Year 5, 10, 15, 20, 25, 30)	$25,000	$69,600
Subtotal:		$5,321,600
25% Contingency		$1,330,400
Projected Opinion of Probable O&M Cost		$6,652,000

Notes:

1) Special Material includes material not amenable to treatment by the selected technology, including sediment from Pond 2 wet containing metals, pesticides, and PCBs;and rubbery, stringy material encountered in NDA.
2) Project Management (5%); Remedial Design (8%); Construction Management (6%) of DCT. (EPA 540 R 00-002, July 2000)
3) Estimated costs are based on conceptual evaluation of the potential alternative, and are subject to change based on future investigations and evaluations.
4) A discount rate of 7% after inflation was assumed for the present worth analysis. (EPA 540 R 00-002, July 2000)

Table F-4b

Alternative 4b

In-Situ Treatment of Ground Water Principal Threat Soil, Low-level Threat Area Low-Permeability Cap, and Expansion and Operation of the Ground Water Treatment System

Maryland Sand, Gravel and Stone Site

Elkton, Maryland

Item Description	Quantity	Unit	Unit Cost	Item Cost
Erosion & Sedimentation Controls	1	lump	$50,000	$50,000
Site Preparation/Clearing	18.0	acre	$6,000	$108,000
Site Fencing/Security	1	lump	$15,000	$15,000
Special Material Excavation and Off-Site Disposal [1]	1,000	cy	$850	$850,000
				$1,023,000
In-Situ Treatment of Principal Threat				
Mobilization/Setup of SPH [2]	1	lump	$200,000	$200,000
In Situ Thermal Treatment	30,000	cy	$200	$6,000,000
Vapor Emission Controls	1	lump	$450,000	$450,000
Sampling/Monitoring	1	lump	$80,000	$80,000
				$6,730,000
Backfill/Geosythetic Cap/Restore Excavated Areas				
Backfill Treated Soil	30,000	cy	$10	$300,000
40 ml Geosynthetic cap	770,000	sf	$1	$770,000
Claymax	770,000	sf	$0.7	$539,000
Geocomposite Drain	770,000	sf	$0.7	$539,000
Cap Vent	770,000	sf	$0.3	$231,000
24" Vegetative Fill	58,000	cy	$14	$812,000
6" Topsoil	14,500	cy	$18	$261,000
Mulching/Seeding	85,556	sy	$1.00	$85,556
				$3,537,556
Vertical Barrier Wall -Full Site				
Mobilization/Set-up	1	lump	$50,000	$50,000
Installation (1300 lf. x 2 ft. wide x 25 ft. deep)	32,500	cf	$16	$520,000
Handling/Grading of Trench Spoils	7,500	cy	$8	$133,600
				$703,600
Extend Groundwater Recovery Trench				
Trench Excavation (20' deep)	300	feet	$400	$120,000
Spoils Treatment	600	ton	$100	$60,000
Trench Backfilling/Restoration	400	cy	$50	$10,000
Piping, Sump, Pump, Controls	1	lump	$30,000	$30,000
				$220,000
Direct Construction Total (DCT)				$12,214,200
Constuction Total				$12,214,200
Performance Test				$100,000
Remedial Design, Construction Oversight, & Project Management (19%) [3]				$2,320,698
Subtotal Construction Cost				$14,634,900
Contingency (30%)				$3,658,725
Total Capital Cost				*$18,294,000*
Total Present Worth O&M Cost				$6,652,000
Projected Opinion of Probable Cost [4]				**$24,950,000**

O&M Costs
Alternative 4b
In-Situ Treatment of Ground Water Principal Threat Soil, Low-level Threat Area Low-Permeability Cap, and Expansion and Operation of the Ground Water Treatment System

Description	Unit Cost	Present Worth [5]
O&M for Cap / Dewatering System (Year 1-30)	$60,000	$745,000
O&M for Exist. GW System (Year 1-5)	$350,000	$1,435,000
O&M for Red. GW System (Year 5-10)	$200,000	$585,000
O&M for Red. GW System (Year 10-30)	$100,000	$539,000
O&M for Site Security (1st Phase - Year 1-5)	$130,000	$533,000
O&M for Site Security (2nd Phase - Year 5-30)	$30,000	$249,000
Upper Sands GW Monitoring (1st Phase - Year 1-10)	$60,000	$421,000
Upper Sands GW Monitoring (2nd Phase - Year 10-30)	$30,000	$162,000
Middle Sands GW Monitoring (1st Phase - Year 1-10)	$60,000	$421,000
Middle Sands GW Monitoring (2nd Phase - Year 10-30)	$30,000	$162,000
EPA 5 Year Review (Year 5, 10, 15, 20, 25, 30)	$25,000	$69,600
Subtotal:		$5,321,600
25% Contingency		$1,330,400
Projected Opinion of Probable O&M Cost		$6,652,000

Notes:

1) Special Material includes material not amenable to treatment by the selected technology, including sediment from Pond 2 wet containing metals, pesticides, and PCBs;and rubbery, stringy material encountered in NDA.

2) In-situ thermal remediation costs based on use of six-phase resistive heating (SPH). Based on supplemental investigations, other in situ technologies such as steam stripping or Chemical Oxidation may be considered.

3) Project Management (5%); Remedial Design (8%); Construction Management (6%) of DCT. (EPA 540-R-00-002, July 2000)

4) Estimated costs are based on conceptual evaluation of the potential alternative, and are subject to change based on future investigations and evaluations.

5) A discount rate of 7% after inflation was assumed for the present worth analysis. (EPA 540-R-00-002, July 2000)

Table F-5
Alternative 5
Ex-Situ Treatment of Ground Water Principal Threat and Low-level Threat Soil, and Expansion and Operation of the Ground Water Treatment System
Maryland Sand, Gravel and Stone Site
Elkton, Maryland

Item Description	Quantity	Unit	Unit Cost	Item Cost
Erosion & Sedimentation Controls	1	lump	$30,000	$30,000
Site Preparation/Clearing	3.0	acre	$6,000	$18,000
Site Fencing/Security	1	lump	$15,000	$15,000
Special Material Excavation and Off-Site Disposal [1]	1,000	cy	$850	$850,000
				$913,000
Excavation of Principal Threat w/On-Site Thermal Desorption				
LTTD Mobilization/Demobilization	1	lump	$500,000	$500,000
Enclosure Structure (incl. set-up @ 3 locations)	1	lump	$450,000	$450,000
Air Handling System	1	lump	$60,000	$60,000
VOC Emission Control Unit (ThermOx)	1	lump	$100,000	$100,000
Sheeting/Shoring for Ex. Below GWT	22,500	sf	$12	$270,000
Excavation Dewatering/Treat Water On-Site	1	lump	$25,000	$25,000
Soil Excavation/Processing	30,000	cy	$20	$600,000
Dewatering/Drying of Saturated Soils	7,000	cy	$16	$112,000
Post Excavation Sampling/Analysis	1	lump	$100,000	$100,000
On-Site HTTD Treatment	3900	ton	$150	$585,000
On Site LTTD Treatment	41,100	ton	$100	$4,110,000
Disposal of Desorbed/Condensed Residuals	1	lump	$100,000	$100,000
				$7,012,000
Excavation of Low Level Soil Threat w/On-Site Thermal Desorption				
LTTD Mobilization/Demobilization (second unit)	1	lump	$500,000	$500,000
Soil Excavation/Processing	310,000	cy	$8	$2,480,000
Dewatering/Drying of Saturated Soils	50,000	cy	$16	$800,000
Post Excavation Sampling/Analysis	1	lump	$30,000	$30,000
On Site Treatment	450,000	ton	$60	$27,000,000
Disposal of Desorbed/Condensed Residuals	1	lump	$100,000	$100,000
				$30,910,000
Backfill/Restore Excavated Areas				
Backfill Treated Soil	495,000	ton	$7	$3,465,000
6" Topsoil	14,300	cy	$18	$257,400
Mulching/Seeding	85,556	sy	$1.00	$85,556
				$3,807,956
Extend Groundwater Recovery Trench				
Trench Excavation (20' deep)	300	feet	$400	$120,000
Spoils Treatment	600	ton	$60	$36,000
Trench Backfilling/Restoration	400	cy	$50	$20,000
Piping, Sump, Pump, Controls	1	lump	$30,000	$30,000
				$206,000
Direct Construction Total (DCT)				$42,849,000

Constuction Total	$42,849,000
Performance Test (Low Temperature Thermal Desorption)	$100,000
Performance Test (High Temperature Thermal Desorption)	$150,000
Remedial Design, Construction Oversight, & Project Management (19%) (2)	$8,141,310
Subtotal Construction Cost	$51,240,300
Contingency (40%)	$20,496,120
Total Capital Cost	$71,736,000
Total Present Worth O&M Cost	$6,213,250
Projected Opinion of Probable Cost (3)	**$77,950,000**

O&M Costs
Alternative 5
Ex-Situ Treatment of Ground Water Principal Threat and Low-level Threat Soil, and Expansion and Operation of the Ground Water Treatment System

Description	Unit Cost	Present Worth (4)
O&M for Exist. GW System (Year 1 15)	$350,000	$3,188,000
O&M for Site Security (1st Phase - Year 1-5)	$130,000	$533,000
O&M for Site Security (2nd Phase - Year 5-15)	$30,000	$150,000
Upper Sands GW Monitoring (Year 1-15)	$60,000	$546,000
Middle Sands GW Monitoring (1st Phase - Year 1-10)	$60,000	$421,000
Middle Sands GW Monitoring (2nd Phase - Year 10-15)	$30,000	$63,000
EPA 5 Year Review (Year 5, 10, 15, 20, 25, 30)	$25,000	$69,600
Subtotal:		$4,970,600
25% Contingency		$1,242,650
Projected Opinion of Probable O&M Cost		$6,213,250

Notes:

1) Special Material includes material not amenable to treatment by the selected technology, including sediment from Pond 2 wet containing metals, pesticides, and PCBs;and rubbery, stringy material encountered in NDA.
2) Project Management (5%); Remedial Design (8%); Construction Management (6%) of DCT. (EPA 540-R-00-002, July 2000)
3) Estimated costs are based on conceptual evaluation of the potential alternative, and are subject to change based on future investigations and evaluations.
4) A discount rate of 7% after inflation was assumed for the present worth analysis. (EPA 540 R 00-002, July 2000)

Table F-5

Alternative 5 (Without Enclosure)

Ex-Situ Treatment of Ground Water Principal Threat and Low-level Threat Soil, and

Expansion and Operation of the Ground Water Treatment System

Maryland Sand, Gravel and Stone Site

Elkton, Maryland

Item Description	Quantity	Unit	Unit Cost	Item Cost
Erosion & Sedimentation Controls	1	lump	$30,000	$30,000
Site Preparation/Clearing	3.0	acre	$6,000	$18,000
Site Fencing/Security	1	lump	$15,000	$15,000
Special Material Excavation and Off-Site Disposal [1]	1,000	cy	$850	$850,000
				$913,000
Excavation of Principal Threat w/On-Site Thermal Desorption				
LTTD Mobilization/Demobilization	1	lump	$500,000	$500,000
Real -time Air Monitoring during excavation	1,000	hour	$100	$100,000
VOC/Dust Suppression Equipment	1	lump	$25,000	$25,000
Sheeting/Shoring for Ex. Below GWT	*22,500*	*sf*	*$12*	*$270,000*
Excavation Dewatering/Treat Water On-Site	1	lump	$25,000	$25,000
Soil Excavation/Processing	30,000	cy	$12	$360,000
Dewatering/Drying of Saturated Soils	7,000	cy	$16	$112,000
Post-Excavation Sampling/Analysis	*1*	*lump*	*$100,000*	*$100,000*
On-Site HTTD Treatment	3900	ton	$150	$585,000
On-Site LTTD Treatment	41,100	ton	$100	$4,110,000
Disposal of Desorbed/Condensed Residuals	1	lump	$100,000	$100,000
				$6,287,000
Excavation of Low Level Soil Threat w/On-Site Thermal Desorption				
LTTD Mobilization/Demobilization (second unit)	1	lump	$500,000	$500,000
Soil Excavation/Processing	310,000	cy	$8	$2,480,000
Dewatering/Drying of Saturated Soils	50,000	cy	$16	$800,000
Post-Excavation Sampling/Analysis	1	lump	$30,000	$30,000
On-Site Treatment	450,000	ton	$60	$27,000,000
Disposal of Desorbed/Condensed Residuals	1	lump	$100,000	$100,000
				$30,910,000
Backfill/Restore Excavated Areas				
Backfill Treated Soil	495,000	ton	$7	$3,465,000
6" Topsoil	14,300	cy	$18	$257,400
Mulching/Seeding	85,556	sy	$1.00	$85,556
				$3,807,956
Extend Groundwater Recovery Trench				
Trench Excavation (20' deep)	300	feet	$400	$120,000
Spoils Treatment	600	ton	$60	$36,000
Trench Backfilling/Restoration	400	cy	$50	$20,000
Piping, Sump, Pump, Controls	1	lump	$30,000	$30,000
				$206,000
Direct Construction Total (DCT)				$42,124,000

Constuction Total	$42,124,000
Performance Test (Low Temperature Thermal Desorption)	$100,000
Performance Test (High Temperature Thermal Desorption)	$150,000
Remedial Design, Construction Oversight, & Project Management (19%) [2]	$8,003,560
Subtotal Construction Cost	$50,377,600
Contingency (40%)	$20,151,040
Total Capital Cost	$70,529,000
Total Present Worth O&M Cost	$6,213,250
Projected Opinion of Probable Cost [3]	**$76,740,000**

O&M Costs
Alternative 5
Ex-Situ Treatment of Ground Water Principal Threat and Low-level Threat Soil, and Expansion and Operation of the Ground Water Treatment System

Description	**Unit Cost**	**Present Worth [4]**
O&M for Exist. GW System (Year 1-15)	$350,000	$3,188,000
O&M for Site Security (1st Phase - Year 1-5)	$130,000	$533,000
O&M for Site Security (2nd Phase - Year 5-15)	$30,000	$150,000
Upper Sands GW Monitoring (Year 1-15)	$60,000	$546,000
Middle Sands GW Monitoring (1st Phase - Year 1-10)	$60,000	$421,000
Middle Sands GW Monitoring (2nd Phase - Year 10-15)	$30,000	$63,000
EPA 5-Year Review (Year 5, 10, 15, 20, 25, 30)	$25,000	$69,600
Subtotal:		$4,970,600
25% Contingency		$1,242,650
Projected Opinion of Probable O&M Cost		$6,213,250

Notes:

1) Special Material includes material not amenable to treatment by the selected technology, including sediment from Pond 2 wet containing metals, pesticides, and PCBs;and rubbery, stringy material encountered in NDA.
2) Project Management (5%); Remedial Design (8%); Construction Management (6%) of DCT. (EPA 540-R-00-002, July 2000)
3) Estimated costs are based on conceptual evaluation of the potential alternative, and are subject to change based on future investigations and evaluations.
4) A discount rate of 7% after inflation was assumed for the present worth analysis. (EPA 540-R-00-002, July 2000)

Final (see P. Flores-Brown's 6-28-03 memo)

BASELINE RISK ASSESSMENT
FOR THE MARYLAND SAND,
GRAVEL AND STONE SITE
ELKTON, MARYLAND

Prepared for

Clean Sites Environmental Services, Inc.
Alexandria, Virginia

Prepared by

ENVIRON Corporation
Arlington, Virginia

May 2000

TABLE 5
Potential Exposure Populations and Pathways Considered in the Baseline Risk Assessment

Exposure Medium/Pathway	Site-Wide[1]					Pond 2 Hot Spot
	On-site Industrial Worker	On-site Maintenance Worker	On-site Resident	Site-Wide Trespasser	Off-site Resident	Pond 2 Trespasser[3]
Soil						
Incidental Ingestion	X	X	X	X	-	X
Dermal Contact	X	X	X	X	-	X
Air						
Inhalation of Vapors	X	X	X	X	X	X
Inhalation of Particulates[2]	-	-	-	-	-	-

Notes:
1 - The identified pathways and populations are evaluated for the entire site, excluding the Pond 2 hot-spot area.
2 - This pathway was evaluated (Appendix F) and was judged not to contribute significantly to risks at the site.
3 - Exposure for this population is expected to occur primarily in the Pond 2 hot spot during infrequent visits to this area. Site-wide exposure is also evaluated for this population.
"X" Indicates that the pathway was evaluated quantitatively in the baseline risk assessment.
"-" Indicates that the pathway was evaluated and was determined to present insignificant exposure and, thus was not further evaluated in the baseline risk assessment.

TABLE 28 Estimated Cancer Risks Associated with Exposure to Soil in the Pond 2 Hot Spot by a Pond 2 Trespasser			
Chemical	Estimated Cancer Risk		
	Soil Ingestion	Dermal Contact	Total Direct Contact with Soil
Central Tendency Exposure			
Benzene	2×10^{-8}	3×10^{-8}	5×10^{-8}
Dibromochloromethane	6×10^{-7}	8×10^{-5}	8×10^{-5}
Tetrachloroethylene	2×10^{-6}	2×10^{-4}	2×10^{-4}
Trichloroethylene	2×10^{-7}	2×10^{-5}	2×10^{-5}
Bis(2-Chloroethyl)Ether	4×10^{-8}	1×10^{-5}	1×10^{-5}
1,4-Dichlorobenzene	1×10^{-7}	3×10^{-5}	3×10^{-5}
Hexachlorobenzene	7×10^{-9}	2×10^{-6}	2×10^{-6}
Aldrin	4×10^{-6}	2×10^{-3}	2×10^{-3}
Aroclor 1242	5×10^{-7}	8×10^{-5}	8×10^{-5}
Total CTE Cancer Risk	7×10^{-6}	2×10^{-3}	2×10^{-3}
Reasonable Maximum Exposure			
Benzene	4×10^{-8}	4×10^{-8}	8×10^{-8}
Dibromochloromethane	1×10^{-6}	1×10^{-4}	1×10^{-4}
Tetrachloroethylene	5×10^{-6}	3×10^{-4}	3×10^{-4}
Trichloroethylene	4×10^{-7}	2×10^{-5}	2×10^{-5}
Bis(2-Chloroethyl)Ether	8×10^{-8}	2×10^{-5}	2×10^{-5}
1,4-Dichlorobenzene	2×10^{-7}	4×10^{-5}	4×10^{-5}
Hexachlorobenzene	1×10^{-8}	3×10^{-6}	3×10^{-6}
Aldrin	8×10^{-6}	3×10^{-3}	3×10^{-3}
Aroclor-1242	9×10^{-7}	1×10^{-4}	1×10^{-4}
Total RME Cancer Risk	1×10^{-5}	3×10^{-3}	3×10^{-3}

TABLE 29 Estimated Noncancer Hazard Quotient Values Associated with Exposure to Soil in the Pond 2 Hot Spot by a Pond 2 Trespasser			
Chemical	**Noncancer HQ Value**		
	Soil Ingestion	**Dermal Contact**	**Total Direct Contact with Soil**
Central Tendency Exposure			
1,1,1-Trichloroethane	5×10^{-3}	8×10^{-3}	1×10^{-2}
Chlorobenzene	4×10^{-2}	9×10^{0}	1×10^{1}
Dibromochloromethane	4×10^{-3}	5×10^{-1}	5×10^{-1}
Tetrachloroethylene	5×10^{-2}	4×10^{0}	4×10^{0}
Toluene	8×10^{-3}	8×10^{-1}	8×10^{-1}
Trichloroethylene	3×10^{-2}	3×10^{0}	3×10^{0}
Hexachlorobenzene	6×10^{-5}	2×10^{-2}	2×10^{-2}
4-Methylphenol	1×10^{-3}	4×10^{-1}	4×10^{-1}
Aldrin	9×10^{-2}	5×10^{1}	5×10^{1}
Aroclor-1242	1×10^{-1}	2×10^{1}	2×10^{1}
Antimony	3×10^{-2}	7×10^{1}	7×10^{1}
Barium	2×10^{-3}	9×10^{-1}	9×10^{-1}
Cadmium	8×10^{-2}	5×10^{1}	5×10^{1}
Chromium	5×10^{-2}	7×10^{1}	7×10^{1}
Copper	1×10^{-3}	6×10^{-2}	6×10^{-2}
Iron	5×10^{-3}	8×10^{-1}	8×10^{-1}
Mercury	6×10^{-2}	8×10^{0}	8×10^{0}
Selenium	2×10^{-3}	8×10^{-2}	8×10^{-2}
Vanadium	2×10^{-2}	2×10^{1}	2×10^{1}
Total CTE Hazard Index	6×10^{-1} (0.6)	3×10^{2} (301)	3×10^{2} (301)
Reasonable Maximum Exposure			
1,1,1-Trichloroethane	1×10^{-2}	1×10^{-2}	2×10^{-2}
Chlorobenzene	7×10^{-2}	1×10^{1}	1×10^{1}
Dibromochloromethane	8×10^{-3}	7×10^{-1}	8×10^{-1}
Tetrachloroethylene	1×10^{-1}	6×10^{0}	6×10^{0}
Toluene	2×10^{-2}	1×10^{0}	1×10^{0}
Trichloroethylene	7×10^{-2}	4×10^{0}	4×10^{0}
Hexachlorobenzene	1×10^{-4}	3×10^{-2}	3×10^{-2}
4-Methylphenol	3×10^{-3}	6×10^{-1}	6×10^{-1}
Aldrin	2×10^{-1}	7×10^{1}	7×10^{1}
Aroclor-1242	3×10^{-1}	3×10^{1}	3×10^{1}
Antimony	5×10^{-2}	1×10^{2}	1×10^{2}
Barium	5×10^{-3}	1×10^{0}	1×10^{0}

TABLE 29
Estimated Noncancer Hazard Quotient Values Associated with Exposure to Soil in the Pond 2 Hot Spot by a Pond 2 Trespasser

Chemical	Noncancer HQ Value		
	Soil Ingestion	Dermal Contact	Total Direct Contact with Soil
Cadmium	2×10^{-1}	6×10^{1}	6×10^{1}
Chromium	1×10^{-1}	9×10^{1}	9×10^{1}
Copper	2×10^{-3}	9×10^{-2}	9×10^{-2}
Iron	9×10^{-3}	1×10^{0}	1×10^{0}
Mercury	1×10^{-1}	1×10^{1}	1×10^{1}
Selenium	3×10^{-3}	1×10^{-1}	1×10^{-1}
Vanadium	4×10^{-2}	3×10^{1}	3×10^{1}
Total RME Hazard Index	1×10^{0} (1.2)	4×10^{2} (423)	4×10^{2} (424)

TABLE 30
Estimated Cancer Risks and Noncancer Hazard Quotient Values Associated with Inhalation Exposure in the Pond 2 Hot Spot by a Pond 2 Trespasser

Chemical	CTE	RME
Inhalation Cancer Risks		
Benzene	3×10^{-10}	9×10^{-10}
Chloroform	2×10^{-10}	7×10^{-10}
1,2-Dichloroethane	2×10^{-10}	7×10^{-10}
1,1-Dichloroethylene	2×10^{-9}	6×10^{-9}
Tetrachloroethylene	2×10^{-10}	5×10^{-10}
1,1,2-Trichloroethane	8×10^{-11}	3×10^{-10}
Trichloroethylene	4×10^{-10}	1×10^{-9}
Vinyl Chloride	7×10^{-10}	2×10^{-9}
Total Inhalation Cancer Risk	4×10^{-9}	1×10^{-8}
Estimated Noncancer Hazard Quotient Values		
Benzene	6×10^{-5}	2×10^{-4}
Chlorobenzene	5×10^{-4}	2×10^{-3}
1,4-Dichlorobenzene	1×10^{-7}	3×10^{-7}
1,2-Dichloroethane	1×10^{-5}	3×10^{-5}
Toluene	2×10^{-5}	5×10^{-5}
1,1,1-Trichloroethane	9×10^{-6}	3×10^{-5}
Inhalation Hazard Index	6×10^{-4}	2×10^{-3}

TABLE 31
Estimated Total Cancer Risks and Noncancer Hazard Index Values Associated with Exposure to the Pond 2 Trespasser

Pathway	Cancer Risk		Noncancer HI Value	
	CTE	RME	CTE	RME
Risks Associated with Pond 2				
Soil Ingestion	7×10^{-6}	1×10^{-5}	0.6	1.2
Dermal Contact	2×10^{-3}	3×10^{-3}	301	423
Vapor Inhalation	4×10^{-9}	1×10^{-8}	0.0006	0.002
Total	2×10^{-3}	3×10^{-3}	301	424
Site-Wide Risks				
Soil Ingestion	4×10^{-7}	1×10^{-6}	0.1	0.3
Dermal Contact	1×10^{-8}	5×10^{-8}	0.02	0.06
Vapor Inhalation	2×10^{-7}	2×10^{-7}	0.02	0.04
Total	6×10^{-7}	1×10^{-6}	0.1	0.4
Total Risks to the Pond 2 Trespasser				
Soil Ingestion	8×10^{-6}	2×10^{-5}	0.7	1.2
Dermal Contact	2×10^{-3}	3×10^{-3}	301	423
Vapor Inhalation	2×10^{-7}	2×10^{-7}	0.02	0.04
Total	2×10^{-3}	3×10^{-3}	301	424

TABLE 32
Estimated Cancer Risks Associated with Direct Contact Exposure to Soil
(Site-Wide[1])

Chemical	Industrial Worker			Maintenance Worker			Trespassing Child			On-Site Resident		
	Soil Ingestion	Dermal Contact	Total Direct Contact Cancer Risk	Soil Ingestion	Dermal Contact	Total Direct Contact Cancer Risk	Soil Ingestion	Dermal Contact	Total Direct Contact Cancer Risk	Soil Ingestion	Dermal Contact	Total Direct Contact Cancer Risk
Central Tendency												
Arsenic	4×10^{-8}	6×10^{-9}	5×10^{-8}	1×10^{-8}	2×10^{-9}	2×10^{-8}	2×10^{-8}	2×10^{-9}	3×10^{-8}	7×10^{-7}	2×10^{-8}	7×10^{-7}
Reasonable Maximum												
Arsenic	7×10^{-7}	1×10^{-7}	9×10^{-7}	3×10^{-7}	5×10^{-8}	3×10^{-7}	5×10^{-8}	5×10^{-9}	5×10^{-8}	7×10^{-6}	2×10^{-7}	7×10^{-6}

Note:
1 - All areas except the Pond 2 Hot Spot

TABLE 33
Estimated Noncancer Hazard Quotient Values Associated with Direct Contact Exposure to Soil
(Site-Wide[1])

Central Tendency

Chemical	Industrial Worker			Maintenance Worker			Trespassing Child			On-Site Resident		
	Soil Ingestion	Dermal Contact	Total Direct Contact HQ Value	Soil Ingestion	Dermal Contact	Total Direct Contact HQ Value	Soil Ingestion	Dermal Contact	Total Direct Contact HQ Value	Soil Ingestion	Dermal Contact	Total Direct Contact HQ Value
Vanadium	4×10^{-3}	6×10^{-3}	1×10^{-2}	1×10^{-3}	2×10^{-3}	3×10^{-3}	2×10^{-3}	2×10^{-3}	3×10^{-3}	3×10^{-2}	1×10^{-2}	4×10^{-2}
Arsenic	1×10^{-3}	2×10^{-4}	2×10^{-3}	5×10^{-4}	6×10^{-5}	5×10^{-4}	6×10^{-4}	5×10^{-5}	7×10^{-4}	1×10^{-2}	3×10^{-4}	1×10^{-2}
Iron	8×10^{-3}	2×10^{-3}	1×10^{-2}	3×10^{-3}	7×10^{-4}	4×10^{-3}	4×10^{-3}	6×10^{-4}	4×10^{-3}	7×10^{-2}	4×10^{-3}	8×10^{-2}
HI Value	1×10^{-2}	8×10^{-3}	2×10^{-2}	5×10^{-3}	3×10^{-3}	7×10^{-3}	6×10^{-3}	2×10^{-3}	8×10^{-3}	1×10^{-1}	1×10^{-2}	1×10^{-1}

Reasonable Maximum

Chemical	Industrial Worker			Maintenance Worker			Trespassing Child			On-Site Resident		
	Soil Ingestion	Dermal Contact	Total HQ Value	Soil Ingestion	Dermal Contact	Total HQ Value	Soil Ingestion	Dermal Contact	Total HQ Value	Soil Ingestion	Dermal Contact	Total HQ Value
Vanadium	1×10^{-2}	2×10^{-2}	4×10^{-2}	5×10^{-3}	9×10^{-3}	1×10^{-2}	3×10^{-3}	4×10^{-3}	7×10^{-3}	1×10^{-1}	4×10^{-2}	1×10^{-1}
Arsenic	5×10^{-3}	7×10^{-4}	5×10^{-3}	2×10^{-3}	3×10^{-4}	2×10^{-3}	1×10^{-3}	1×10^{-4}	1×10^{-3}	3×10^{-2}	1×10^{-3}	4×10^{-2}
Iron	3×10^{-2}	9×10^{-3}	4×10^{-2}	1×10^{-2}	3×10^{-3}	1×10^{-2}	8×10^{-3}	1×10^{-3}	9×10^{-3}	2×10^{-1}	1×10^{-2}	2×10^{-1}
HI Value	5×10^{-2}	3×10^{-2}	8×10^{-2}	2×10^{-2}	1×10^{-2}	3×10^{-2}	1×10^{-2}	5×10^{-3}	2×10^{-2}	3×10^{-1}	5×10^{-2}	4×10^{-1}

Note:
1 - All areas except the Pond 2 Hot Spot

TABLE 34
Estimated Cancer Risks Associated with Inhalation Exposure to Emissions from On-Site Source Areas and Air Stripper

Chemical	Industrial Worker		Maintenance Worker		On-Site Resident		Trespassing Child		Off-Site Resident	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME
Benzene	1×10^{-9}	2×10^{-8}	3×10^{-11}	5×10^{-10}	1×10^{-8}	5×10^{-8}	7×10^{-11}	2×10^{-10}	2×10^{-8}	9×10^{-8}
Chloroform	1×10^{-9}	2×10^{-8}	3×10^{-11}	6×10^{-10}	8×10^{-9}	4×10^{-8}	8×10^{-11}	3×10^{-10}	7×10^{-9}	4×10^{-8}
1,2-Dichloroethane	1×10^{-9}	2×10^{-8}	3×10^{-11}	5×10^{-10}	8×10^{-9}	4×10^{-8}	7×10^{-11}	2×10^{-10}	1×10^{-8}	5×10^{-8}
1,1-Dichloroethylene	8×10^{-9}	1×10^{-7}	2×10^{-10}	3×10^{-9}	6×10^{-8}	3×10^{-7}	4×10^{-10}	1×10^{-9}	9×10^{-8}	4×10^{-7}
Tetrachloroethylene	7×10^{-10}	1×10^{-8}	2×10^{-11}	5×10^{-10}	6×10^{-9}	3×10^{-8}	6×10^{-11}	2×10^{-10}	2×10^{-9}	8×10^{-9}
1,1,2-Trichloroethane	4×10^{-10}	6×10^{-9}	1×10^{-11}	5×10^{-10}	3×10^{-9}	1×10^{-8}	3×10^{-11}	1×10^{-10}	1×10^{-9}	5×10^{-9}
Trichloroethylene	2×10^{-9}	3×10^{-8}	5×10^{-11}	1×10^{-9}	2×10^{-8}	8×10^{-8}	1×10^{-10}	4×10^{-10}	8×10^{-9}	4×10^{-8}
Vinyl Chloride	3×10^{-9}	6×10^{-8}	6×10^{-11}	1×10^{-9}	3×10^{-8}	1×10^{-7}	2×10^{-10}	5×10^{-10}	6×10^{-8}	3×10^{-7}
Total Cancer Risk	2×10^{-8}	3×10^{-7}	4×10^{-10}	8×10^{-9}	1×10^{-7}	7×10^{-7}	1×10^{-9}	3×10^{-9}	2×10^{-7}	9×10^{-7}

TABLE 35
Estimated Hazard Quotient Values Associated with Inhalation Exposure to Emissions from On-Site Source Areas and Air Stripper

Chemical	Industrial Worker		Maintenance Worker		On-Site Resident		Trespassing Child		Off-Site Resident	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME
Benzene	4×10^{-4}	1×10^{-3}	8×10^{-6}	3×10^{-5}	2×10^{-3}	2×10^{-3}	2×10^{-5}	5×10^{-5}	3×10^{-3}	4×10^{-3}
Chlorobenzene	3×10^{-3}	1×10^{-2}	5×10^{-5}	2×10^{-4}	1×10^{-2}	2×10^{-2}	1×10^{-4}	4×10^{-4}	2×10^{-2}	3×10^{-2}
1,4-Dichlorobenzene	6×10^{-7}	2×10^{-6}	2×10^{-8}	8×10^{-8}	2×10^{-6}	4×10^{-6}	4×10^{-8}	1×10^{-7}	8×10^{-7}	1×10^{-6}
1,2-Dichloroethane	6×10^{-5}	2×10^{-4}	1×10^{-6}	6×10^{-6}	2×10^{-4}	4×10^{-4}	3×10^{-6}	1×10^{-5}	3×10^{-4}	4×10^{-4}
Toluene	9×10^{-5}	3×10^{-4}	2×10^{-6}	8×10^{-6}	4×10^{-4}	6×10^{-4}	5×10^{-6}	1×10^{-5}	6×10^{-4}	9×10^{-4}
1,1,1-Trichloroethane	5×10^{-5}	2×10^{-4}	1×10^{-6}	4×10^{-6}	2×10^{-4}	3×10^{-4}	2×10^{-6}	7×10^{-6}	3×10^{-4}	4×10^{-4}
Hazard Index	3×10^{-3}	1×10^{-2}	7×10^{-5}	3×10^{-4}	1×10^{-2}	2×10^{-2}	1×10^{-4}	5×10^{-4}	3×10^{-2}	4×10^{-2}

TABLE 36
Estimated Total Cancer Risks and Noncancer Hazard Index Values Associated with Exposure to Chemicals in Soil and Air (Site-Wide[a])

Pathway	Industrial Worker		Maintenance Worker		On-Site Resident		Trespassing Child		Off-Site Resident	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME
Estimated Excess Cancer Risk										
Soil Ingestion	4×10^{-8}	7×10^{-7}	1×10^{-8}	3×10^{-7}	7×10^{-7}	7×10^{-6}	2×10^{-8}	5×10^{-8}	NA	NA
Dermal Contact	6×10^{-9}	1×10^{-7}	2×10^{-9}	5×10^{-8}	2×10^{-8}	2×10^{-7}	2×10^{-9}	5×10^{-9}	NA	NA
Vapor Inhalation	2×10^{-8}	3×10^{-7}	4×10^{-10}	8×10^{-9}	1×10^{-7}	7×10^{-7}	1×10^{-9}	3×10^{-9}	2×10^{-7}	9×10^{-7}
Total Cancer Risk	7×10^{-8}	1×10^{-6}	2×10^{-8}	4×10^{-7}	9×10^{-7}	8×10^{-6}	3×10^{-8}	5×10^{-8}	2×10^{-7}	9×10^{-7}
Estimated Noncancer Hazard Index (HI) Values										
Soil Ingestion	1×10^{-2}	5×10^{-2}	5×10^{-3}	2×10^{-2}	1×10^{-1}	3×10^{-1}	6×10^{-3}	1×10^{-2}	NA	NA
Dermal Contact	8×10^{-3}	3×10^{-2}	3×10^{-3}	1×10^{-2}	1×10^{-2}	5×10^{-2}	2×10^{-3}	5×10^{-3}	NA	NA
Vapor Inhalation	3×10^{-3}	1×10^{-2}	7×10^{-5}	3×10^{-4}	1×10^{-2}	2×10^{-2}	1×10^{-4}	5×10^{-4}	3×10^{-2}	4×10^{-2}
Total HI Value	3×10^{-2}	9×10^{-2}	7×10^{-3}	3×10^{-2}	2×10^{-1}	4×10^{-1}	8×10^{-3}	2×10^{-2}	3×10^{-2}	4×10^{-2}

Notes:
NA - Not applicable
Total cancer risks and HI values may not be equivalent to the sum of the individual pathway risks due to rounding.
a - Risks based on exposure in areas of site outside of the Pond 2 hot spot.

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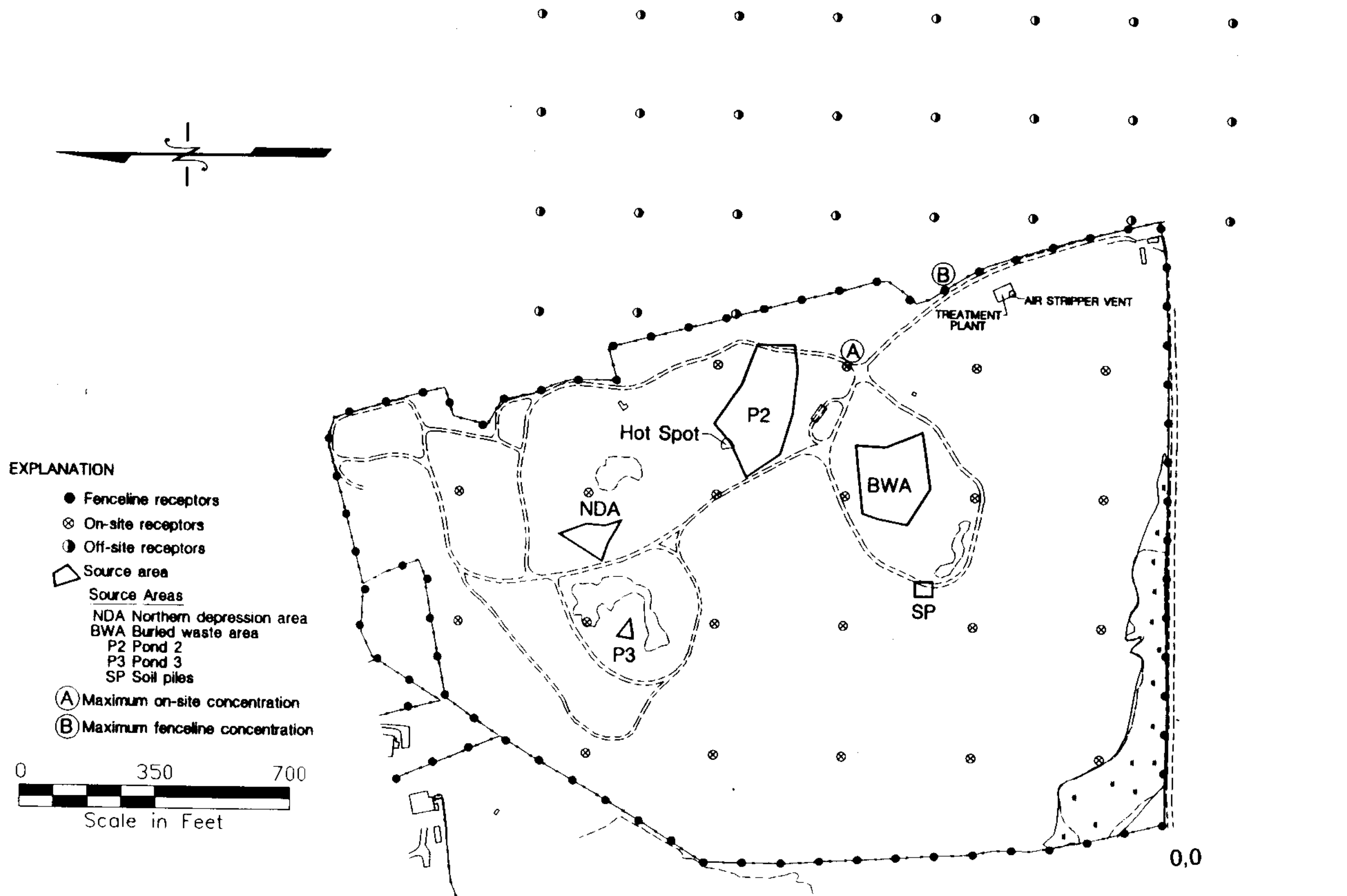

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RECEPTOR LOCATIONS FOR DISPERSION MODELING
AND LOCATIONS OF MAXIMUM ON-SITE AND OFF-SITE AIR CONCENTRATIONS

Figure
2

BASELINE RISK ASSESSMENT ADDENDUM
HUMAN HEALTH RISKS ASSOCIATED
WITH EXPOSURE TO SUBSURFACE SOILS
MARYLAND SAND, GRAVEL AND STONE SITE
ELKTON, MARYLAND

Prepared for

Clean Sites Environmental Services, Inc.
Alexandria, Virginia

Prepared by

ENVIRON Corporation
Arlington, Virginia

August 2000

TABLE 11 Estimated Cancer Risks and HI Values for NDA					
Receptor		**Cancer**		**Noncancer**	
		CTE	**RME**	**CTE**	**RME**
On-Site Industrial Worker					
	Ingestion of soil	6×10^{-5}	1×10^{-3}	5	16
	Dermal contact	8×10^{-6}	2×10^{-4}	1	4
	Inhalation of vapor	3×10^{-5}	3×10^{-4}	21	32
	Total	1×10^{-4}	1×10^{-3}	27	52
On-Site Resident					
	Ingestion of soil	1×10^{-3}	1×10^{-2}	43	121
	Dermal contact	2×10^{-5}	3×10^{-4}	2	7
	Inhalation of vapor	2×10^{-4}	5×10^{-4}	69	55
	Total	1×10^{-3}	1×10^{-2}	114	183

TABLE 12 Total Estimated Cancer Risks for MSGS Source Areas				
Area	**On-site Industrial Worker**		**On-site Resident**	
	CTE	**RME**	**CTE**	**RME**
ASP1	4×10^{-7}	7×10^{-6}	6×10^{-6}	5×10^{-5}
BWA	3×10^{-5}	2×10^{-4}	2×10^{-4}	5×10^{-4}
NDA	1×10^{-4}	1×10^{-3}	1×10^{-3}	1×10^{-2}
Pond 01	5×10^{-7}	4×10^{-6}	3×10^{-6}	2×10^{-5}
Pond 02	9×10^{-6}	8×10^{-5}	6×10^{-5}	2×10^{-4}
Pond 03	1×10^{-6}	1×10^{-5}	1×10^{-5}	7×10^{-5}
SP	6×10^{-7}	4×10^{-6}	3×10^{-6}	1×10^{-5}
SSA	2×10^{-9}	2×10^{-8}	1×10^{-8}	4×10^{-8}

TABLE 13 Total Estimated HI Values for MSGS Source Areas				
Area	On-site Industrial Worker		On-site Resident	
	CTE	RME	CTE	RME
ASP1	0.04	0.1	0.3	0.8
BWA	0.4	0.8	2	2
NDA	27	52	114	183
Pond 01	0.03	0.09	0.2	0.4
Pond 02	0.4	0.8	2	3
Pond 03	0.5	1	2	5
SP	0.03	0.09	0.1	0.4
SSA	0.02	0.08	0.1	0.4

TABLE 14 Estimated Cancer Risks Associated with Ingestion of On-Site Soils				
Area	On-Site Industrial Worker		On-Site Resident	
	CTE	RME	CTE	RME
ASP1	3×10^{-7}	6×10^{-6}	6×10^{-6}	5×10^{-5}
BWA	7×10^{-7}	1×10^{-5}	1×10^{-5}	1×10^{-4}
NDA	6×10^{-5}	1×10^{-3}	1×10^{-3}	1×10^{-2}
Pond 01	6×10^{-8}	9×10^{-7}	9×10^{-7}	8×10^{-6}
Pond 02	5×10^{-7}	9×10^{-6}	9×10^{-6}	8×10^{-5}
Pond 03	4×10^{-7}	7×10^{-6}	7×10^{-6}	6×10^{-5}
SP	1×10^{-8}	2×10^{-7}	2×10^{-7}	1×10^{-6}
SSA	5×10^{-11}	9×10^{-10}	8×10^{-10}	8×10^{-9}

TABLE 15 Estimated Cancer Risks Associated with Dermal Contact with On-Site Soils				
Area	On-Site Industrial Worker		On-Site Resident	
	CTE	RME	CTE	RME
ASP1	5×10^{-8}	9×10^{-7}	1×10^{-7}	2×10^{-6}
BWA	4×10^{-8}	7×10^{-7}	1×10^{-7}	1×10^{-6}
NDA	8×10^{-6}	2×10^{-4}	2×10^{-5}	3×10^{-4}
Pond 01	7×10^{-9}	1×10^{-7}	2×10^{-8}	3×10^{-7}
Pond 02	7×10^{-8}	1×10^{-6}	2×10^{-7}	3×10^{-6}
Pond 03	7×10^{-8}	1×10^{-6}	2×10^{-7}	2×10^{-6}
SP	2×10^{-10}	5×10^{-9}	8×10^{-10}	9×10^{-9}
SSA	1×10^{-13}	3×10^{-12}	5×10^{-13}	5×10^{-12}

TABLE 16 Estimated Cancer Risks Associated with Inhalation of Vapors				
Area	On-Site Industrial Worker		On-Site Resident	
	CTE	RME	CTE	RME
ASP1	0	0	0	0
BWA	2×10^{-5}	2×10^{-4}	1×10^{-4}	4×10^{-4}
NDA	3×10^{-5}	3×10^{-4}	2×10^{-4}	5×10^{-4}
Pond 01	4×10^{-7}	3×10^{-6}	2×10^{-6}	6×10^{-6}
Pond 02	9×10^{-6}	6×10^{-5}	5×10^{-5}	1×10^{-4}
Pond 03	6×10^{-7}	5×10^{-6}	4×10^{-6}	9×10^{-6}
SP	5×10^{-7}	4×10^{-6}	3×10^{-6}	8×10^{-6}
SSA	2×10^{-9}	2×10^{-8}	1×10^{-8}	3×10^{-8}

TABLE 17 Estimated Noncancer Risks Associated with Ingestion of On-Site Soils				
Area	**On-Site Industrial Worker**		**On-Site Resident**	
	CTE	**RME**	**CTE**	**RME**
ASP1	0.03	0.1	0.3	0.7
BWA	0.046	0.15	0.4	1.1
NDA	5	16	43	121
Pond 01	0.014	0.05	0.13	0.35
Pond 02	0.07	0.2	0.6	2
Pond 03	0.1	0.5	1.3	4
SP	0.013	0.04	0.1	0.3
SSA	0.01	0.04	0.1	0.3

TABLE 18 Estimated Noncancer Risks Associated with Dermal Contact with On-Site Soils				
Area	On-Site Industrial Worker		On-Site Resident	
	CTE	RME	CTE	RME
ASP1	0.01	0.04	0.02	0.07
BWA	0.02	0.07	0.03	0.1
NDA	1.0	4	2	7
Pond 01	9×10^{-3}	0.03	0.02	0.05
Pond 02	0.03	0.1	0.05	0.2
Pond 03	0.06	0.2	0.1	0.3
SP	9×10^{-3}	0.04	0.02	0.06
SSA	8×10^{-3}	0.03	0.01	0.05

TABLE 19 Estimated Noncancer Risks Associated with Inhalation of Vapors				
Area	On-Site Industrial Worker		On-Site Resident	
	CTE	RME	CTE	RME
ASP1	2×10^{-6}	3×10^{-6}	6×10^{-6}	5×10^{-6}
BWA	0.38	0.56	1.2	1.0
NDA	21	32	69	55
Pond 01	3×10^{-3}	5×10^{-3}	0.01	9×10^{-3}
Pond 02	0.3	0.45	1.0	0.8
Pond 03	0.3	0.4	0.8	0.7
SP	4×10^{-3}	6×10^{-3}	0.01	0.01
SSA	3×10^{-3}	5×10^{-3}	0.01	8×10^{-3}

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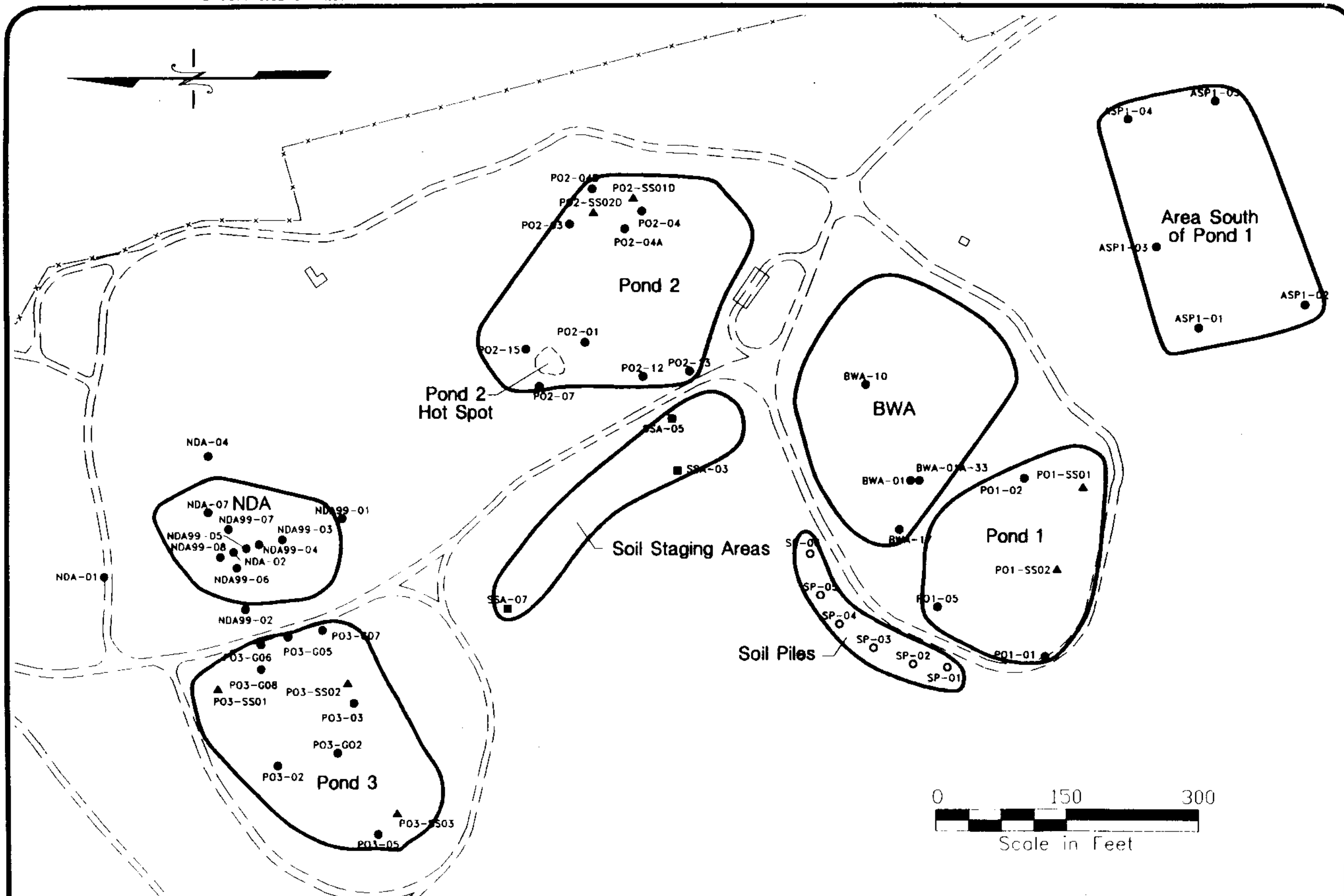

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MARYLAND SAND, GRAVEL AND STONE
ELKTON, MARYLAND

Figure 2